THE WORLD IS ITS FIELD.

THE ENGINEERING MAGAZINE

VOL. XIX. JULY, 1900. NO. 4.

ENGINEERING DEVELOPMENT OF THE FAR EAST.

By Wm. Barclay Parsons.

EVERY one knows that the Chinese once led the world in scientific and material development, but that they were acquainted with the principles of good engineering design was a surprise to me. At the seaports where foreigners have resided, or even in those portions of the Empire into which foreign ideas might have penetrated, it was expected to see structures bearing the imprint of modern skill in design or construction; but it was not expected to find such things in the unexplored interior, remotely or entirely removed from outside influences, and of such self-evident age as to stamp them as genuinely Chinese, both in workmanship and plan.

The structures that impress the engineering observer most strongly are the bridges, the pagodas, the city walls and certain details of building construction. The arch, that beautiful structure from the scientific as well as the æsthetic point of view, is generally believed to be of Roman origin. It was not known to, or at least never used

Mr. Parsons' article—the third of a striking series just published in THE ENGINEERING MAGAZINE—puts in concise and almost epigrammatic form his conclusions as to the promise the great empire of China holds for the western engineering world. It is "the richest commercial prize of the age." Interest in Far Eastern affairs grows tense with recent news from Pekin, suggesting that the hopeless mediævalism of China's court would try a definite issue with fast advancing material civilization. This is discussed more fully in the Editorial Comment in this issue.—THE EDITORS.

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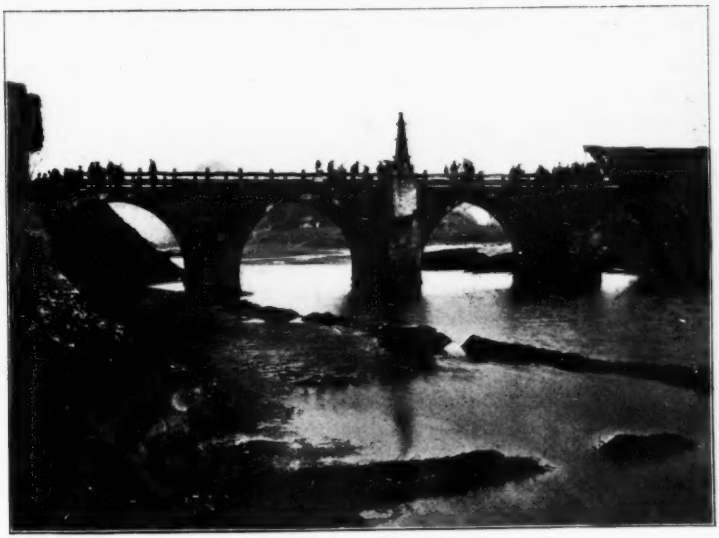
by, the Greeks; and although the shape appears in certain specimens of Hindoo architecture, it is of false variety—that is, a succession of protruding corbels. In China, on the other hand, we find it of most widespread and general application, and examination shows that the principles involved are thoroughly understood, as the arches are composed of a complete ring of voussoirs, radially jointed and of proper proportions. Moreover, the arch ring is always continued down to the spring, and not built in connection with the spandrels, as is commonly done elsewhere. The general use of the design in all parts of the country and the undoubted antiquity of so many of

A VERY OLD STONE ARCH.

the existing examples clearly demonstrate that it long antedates any possible foreign suggestions, and go a long way to establish it as of Chinese origin—a development, however, which, like printing and gunpowder and so many other inventions and discoveries, never passed beyond the national borders.

The largest application of the arch principle is in the building of bridges, where spans of thirty to forty feet are common, while single spans of fifty feet are seen and larger ones probably exist. Longer spans than these are not usually required, as those streams which can be bridged do not, as a rule, call for single openings larger than will suffice to pass small boats. The arches are usually of the

A FINE SINGLE SPAN.



PING HSIANG BRIDGE. A PERFECT SPECIMEN.

full half-circle, with the spring above the ordinary flow line. The arch joints are cut close and filled with hard, firm mortar, while the spandrels are always built independently of the arch, and usually of inferior workmanship, indicating clearly that the designer understood

THE STONE ARCH USED FOR A CULVERT.

the theory. The piers frequently have V-shaped ends up stream, probably to diminish scouring action and to prevent drift trash from catching, as such additions are common even in the southern districts where ice is unknown. The roadway is guarded by carved railings in the case of the more elaborate structures, or by a solid parapet, some of the latter that I saw being composed of concrete. These arches have a grace of outline based on proper proportion, a solidity in appearance from good construction, coupled with a very evident sound application of theory to practical uses in accordance with the requirements of local conditions—considerations that stamp them as construction works of a very high order, although their size, as compared with arches in other lands, may be small.

With the freedom that a designer takes when he is sure of his principles, some of the Chinese arches take extraordinary shape, such as the single span near Peking, carried to a height seemingly out of

all proportion in order to pass boats with short masts; and yet, such a design, in a locality without wheeled vehicles where a short excessive gradient is not a serious matter, not only meets the requirement of economical planning but adds also the charm of irregularity, which, in a country distinguished for sameness and lack of contrast, is especially attractive.

The Chinaman is very much like a cat—he objects to getting his feet wet; and as he carries his own loads, which he thinks he can do more cheaply than by horse or carriage, he sees to it that all streams are bridged. The arch he uses nearly always in the large structures, and carries it down in the scale even to small culverts; although, when he begins to deal with little openings, he frequently makes use of stone stringers. If suitable stones can be procured he does not hesitate to be bold, as some beams I measured were 30 feet long and 15 inches deep. In other instances the effective spans were made shorter

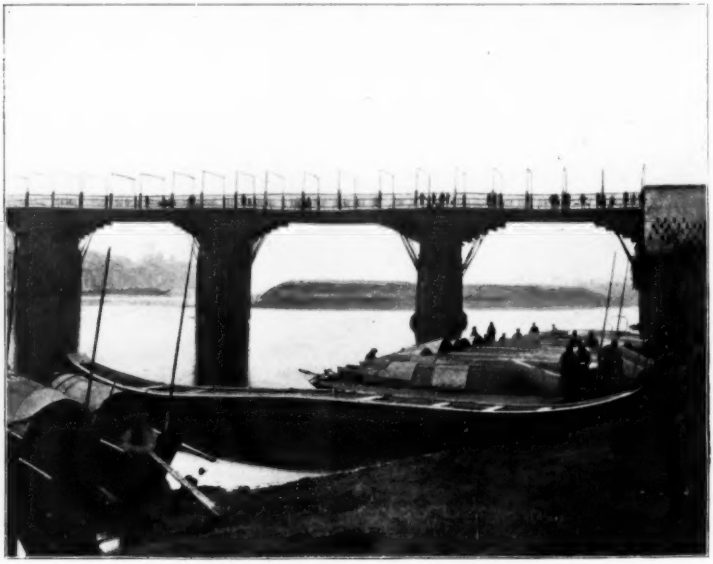
BRIDGE OF CHINESE DESIGN AND CONSTRUCTION NEAR PEKIN.
Designed to allow the passage of masted junks.

by placing corbels beneath the ends of the stringers, and occasionally intermediate supports were furnished by framed bents of long stones, exactly like the ordinary American timber construction.

But the most remarkable bridge I saw was a wooden cantilever,

in the eastern part of Hu-nan, the most anti-foreign section of the whole empire, and in a part of that province which no white man had ever previously approached. This bridge consisted of six spans, with a length of 480 feet and a width of 20 feet, paved with cobble stones, while a frame is in place to carry awning mats in summer. The substructure is masonry piers in good condition, but evidently of good age, while the superstructure is of wood and a genuine cantilever in design. It is constructed with layers of timbers, alternating in direction at right angles to each other, and so building out the arms from the piers until the intervening space is short enough to be spanned by a single piece. The superstructure is not so old as the substructure, the timber having been undoubtedly replaced, possibly many times; but it was, when visited, in horrible condition of decay. It will stand, however, without repairs or attention—as all structures in China are allowed to go—until some day an extra-large crowd will be too much for the rotten timbers to hold up and it will collapse with great loss of life.

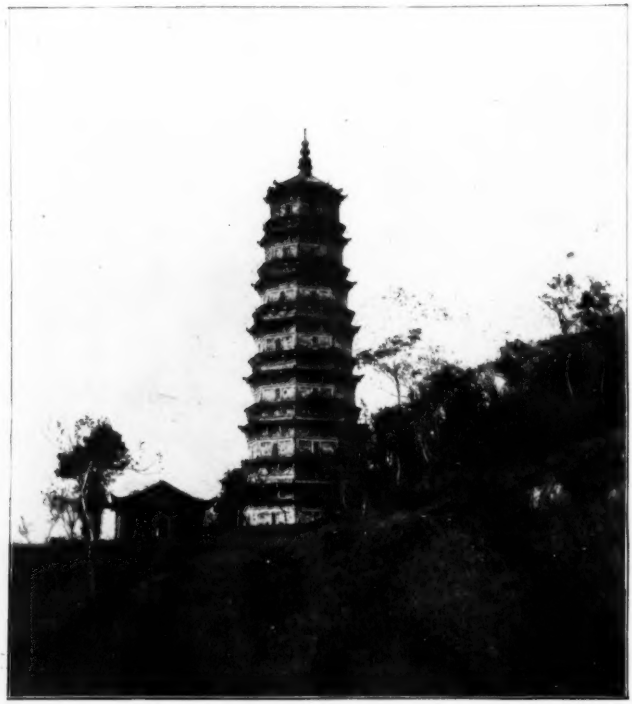
From the point of view of artistic and essentially Oriental design the pagoda possesses the most interest. These singular constructions, at least one of which nearly every city possesses, fairly dot the



LI LING CANTILEVER, BUILT OF WOOD

STONE STRINGER AND SMALL PAGODA.

surface of the country. Their purpose appears to be twofold—either as monuments commemorating the virtues or the munificence of some departed benefactor, or as agents of "fêng shui" (literally "wind and water"), the spirit genius of good and evil, which, if properly propitiated, will ward off pestilence and famine and permit only prosperity and happiness to visit the neighborhood. These very curious towers are of great antiquity, Chinese records authenticating their origin at least as far back as the early part of the Christian era. In size they vary from the little ones, which are nothing more than roadside shrines, to what was once the most beautiful and largest—the celebrated porcelain pagoda of Nanking, destroyed in the Taiping rebellion. This extraordinary structure had a height of 261 feet, was built of masonry and covered with glazed tiles of many colors, and was a monument to native skill in erection as well as to artistic sense in design. Unfortunately, most of the large pagodas are being allowed to crumble to decay, although some are tended and give hope of standing for other generations to admire. The prominent ones vary in height from 100 to 200 feet, are usually octagonal in plan, with



WU CHANG PAGODA.

straight but tapering sides, and always are composed of an odd number of stories; although sometimes these stories are double ones, as in the case of the Wu-chang pagoda, one of the most beautiful and best preserved in the country. They are always plumb, and if now in bad condition, it is the result of lack of care and the ravages of time and not of original faulty construction. Chinese houses conform to certain general types; therefore, in its wide range of size and of decorations, from the severely plain stone structure to the one covered with colored tiles, the pagoda marks one of the few breaks in the characteristically national rule of uniformity and furnishes as well an interesting construction study.

The method of putting up buildings with a rigid frame and then encasing them with thin masonry walls is supposed to be something essentially American; but, like so many designs claimed as modern,

it finds a universal application all over China. Although the Chinaman has everywhere at hand brick-making clay, the product is not good, owing to his unfortunate tendency to over-economy—which, in this particular case, takes the form of insufficient burning. To give sufficient rigidity, house walls have to be made thick, and thick walls he found, as we have found, encroach seriously on floor space; therefore, he has developed "cage construction." The materials employed are usually round timbers, connected by mortise and pin joints, while the roof truss is a peculiar and ingenious combination of beams, taking load near the abutments only. The accompanying illustration shows such a building in process of being encased.

If the arches display a knowledge of theory, the houses are ingenious applications of practice, and the pagodas an appreciation of

AN EXAMPLE OF CHINESE CAGE CONSTRUCTION.

the beautiful. The walls, without which no large city in China exists, and which reach their maximum in Peking or in the even more famous Great Wall, are an evidence that our Oriental friend was equally at home with large construction. These great structures, with

their massive proportions (as in the Great Wall, with its length of 1,500 miles across wild hills and desert valleys), with their keeps and arched gateways, with their parapets and moats, fill the observer with admiration.

That the Chinaman has been in the past an engineer of no mean ability, there is no question; but it will be asked: What of the future? Is he going to let things rest as they are, or will he set about to learn the newer forms of applied science, especially in the direction in which

A PART OF THE FAMOUS GREAT WALL.

he is most deficient—improved and modern methods of transportation? Will he appreciate the necessity of railroads and steamboats, and if instructed will he use them; and, furthermore, when he has working examples to study, will he go ahead on his own account and construct and operate his own lines?

The engineering progress of the Chinaman has been along static rather than dynamic lines—that is, he has learned how to construct bridges, erect pagodas, and concentrate his forces to build a wall fifteen hundred miles long, but not how to construct a machine, nor to do any of the things the basal principle of which is *movement*.

Perhaps this is due to the similar traits that we find forming

the framework of his national character; or, perhaps, it is due to his dread of displacing manual labor and his baseless fear of depriving his fellow man of work. But no matter the cause, this marks the cleavage line along which foreign inspiration in the art of construction will find an outlet for development.

In solid, stationary structures, the Chinaman can supply his own needs unaided; but the field for producing those aggregations of engineering and mechanical skill based on the theory or application of movement, especially of economical movement, lies unbroken and the soil is rich. The idea of economy of movement is absolutely lacking in the Chinese—a singular circumstance, as there is no other nationality so strongly economical, even to the point of parsimony. This trait is shown in his dwellings, in his clothes, and in

PEKING WALL AND GATE.

all his details of living, except in those where movement is the main theme. The development that is to come will be, therefore, along this line, and will show itself primarily in methods of moving people and goods—namely, in means of transportation; secondly, in the methods of moving the great untouched mineral wealth from its existing subterranean hiding places to the surface, that is, in mining; and thirdly, in all matters of construction whose parts are moving—namely, machines.

The first of these is self-evident, and has already been treated in my article upon "Railway Development in the Orient," which was published in the May issue of THE ENGINEERING MAGAZINE. The development has already begun. The second, mining, is about to begin, but is dependent on one form of the devices under the third head—the means of moving water. The third class is general in its character and will include all kinds of machines, of which the most important class is hydraulics.

The science of handling water is practically unknown in China; the Chinese pump is a most crude and uneconomical device, and wholly incapable of raising water to a height above that of a few feet, and the lack of proper and efficient devices has absolutely prevented the development of China's mineral resources. Mining by native methods has consisted in sinking a shaft or an inclined drift down the vein until water was encountered, or until coolies could no longer raise the load on their backs, a limit in the latter case of about 200 feet. When one of these contingencies is reached the mine is abandoned. In order to develop the mineral wealth, the first requisite is a pumping plant; the second, of much less importance, is elevating machinery. The pump, however, will find many applications other than those involved in mining, namely, in supplying the crowded cities with water, for protection against fire (a source of great annual loss), and, where aided by automatic appliances, such as wind mills, for irrigation, or the reclamation of low lands subject to annual inundation.

If, therefore, I were asked to enumerate the relative importance of engineering development, I should reply—means of transportation; hydraulic machinery; mining; and then, those machines which can compete against a very low-priced manual labor, and which can, if possible, enter a field of work not now undertaken, such as electric lighting, or enter the existing fields so as to change present conditions without too violent or immediately revolutionary effects.

THE SHIP-BUILDING YARDS OF THE UNITED STATES.

By Waldon Fawcett.

THE opening of the new century will find the ship-yards of the United States occupying a position as a factor in the world's producers of naval and mercantile tonnage which certainly could scarcely have been anticipated a few years ago. The best informed men in the industry estimate that the growth during the closing three years of the century will be fully equal to that of any decade which intervened between the inauguration of metal-shipbuilding on the western side of the Atlantic and the year 1898. A review of the number of ship-building companies which have been incorporated and the new plants which have been established within the interval named would seem to afford justification for the claim.

The United States have commenced the present fight for a foremost place among ship-building nations—a struggle upon which they are now fairly entered—under conditions somewhat different from those which obtained in the case of other nations, or even from those existing in America when the clipper ships gained for her the supremacy of the seas. Great natural storehouses of material in the American forests gave the new nation a considerable advantage, and this was augmented by the impetus given to Yankee inventive ability by the emoluments certain to accrue to the builder of a speedy and powerful privateer. On the other hand, Great Britain in the early development of the metal vessels had the field largely to herself, and she in turn had the advantage of superior sources of material supply. Recognition may well be made at the outset, therefore, of the fact that the United States are seeking to regain their position in the ship-building world under the fiercest competitive conditions; and while

The revival of American ship-building is to be traced not to any artificial stimulus of subsidy or protection, but to the free natural expansion of wonderful resources of material and to the constant study and use of means for labor-saving. It is along these lines that the United States must look for further progress. The long-torpid industry is already awakening, and Mr. Fawcett's rapid review of its strength is very valuable. His paper will be continued in the August issue of THE ENGINEERING MAGAZINE.—THE EDITORS.

the recent execution by American builders of Japanese and Russian naval contracts may not have the significance which has been attached to it in certain quarters, it is not without moment.

Enumerating all ship-building plants of whatsoever magnitude, and whether engaged in the construction of wooden or metal vessels, there are in the United States more than 325 ship-yards. Of this number something more than 250 are located on the Atlantic and Pacific coasts and the inland rivers, while about 75 are situated on the great lakes and the connecting waterways. The total just given, while it includes a number of builders of yachts and small craft of every description, makes no account of the engine and boiler manufacturers whose work is almost exclusively of a marine character, although a number of them frequently contract for the construction of vessels, sub-letting the contract for hull construction. There are 85 of these engine and boiler manufacturers on the Atlantic and Pacific coasts and an even greater number on the great lakes.

That the ship-yards of the country are in a generally prosperous condition is indicated by the fact that, during the last six months of 1899 and the first four months of 1900, there was only one failure among firms operating plants of any magnitude. On the other hand, a number of ship-building establishments which had been closed for some time were re-opened, and there was scarcely one of the more prominent institutions which did not inaugurate enlargements or improvements, these extensions amounting in some instances to a virtual doubling of the capacity of the yard. Most significant of all is the fact that, in the interval mentioned, there were projected ten new ship-building corporations which propose to erect plants entailing outlays ranging all the way from $500,000 to $6,000,000. Some of these new projects are already well advanced, and if all are carried out on the lines mapped out the aggregate expenditure will exceed $20,000,000.

The contracts in the hands of the American ship-builders afford an equally satisfactory showing. There are now building or under contract in the ship-yards of the United States mercantile and naval tonnage which represents an aggregate value, exclusive of the armor and armament for the naval vessels, of $69,000,000. Of this total, the naval vessels building for the United States Navy Department foot up, in round numbers, $34,500,000; the two Russian war vessels, building at the yard of Wm. Cramp & Sons Co., $5,000,000; the mercantile vessels on the Atlantic and Pacific coasts, $18,000,000; the mercantile vessels on the great lakes, $10,000,000; and the mercantile craft on the inland rivers, $1,500,000.

Comparing this showing with the volume of business on hand in the early summer of 1899, we find a distinct gain of $7,000,000 in the value of contracts, inasmuch as the commissions in the hands of the builders at that time amounted to an approximate $62,000,000. That the growth of the industry is, moreover, even greater than evidenced by these figures may be appreciated by a comparison of the sundry items which go to make up each total. The $62,000,000 worth of work on hand in the summer of 1900 was made up of naval contracts amounting to $42,000,000; mercantile vessels in the inland river yards valued at $800,000; mercantile vessels building on the lakes, $3,000,000; and mercantile vessels building on the Atlantic and Pacific coasts, $16,000,000. It will thus be seen that whereas the volume of naval work fell off $8,000,000, without taking into consideration the Russian contracts, the value of the ships building on the inland rivers was almost doubled; the aggregate of contracts at the great lake yards was more than trebled, and the plants on the Atlantic and Pacific coasts show an increase of many per cent. in the commissions on their books.

GENERAL VIEW OF THE PLANT OF THE NEWPORT NEWS SHIPBUILDING AND DRY-DOCK COMPANY, NEWPORT NEWS, VA.

The ground for the claim that an estimate of the development of American ship-building must not be based solely on the $7,000,000 increase of the year 1899-1900 over the year 1898-99 is found in the contention that the drop in the volume of naval work is but temporary. The United States government is carrying out a fixed policy for the

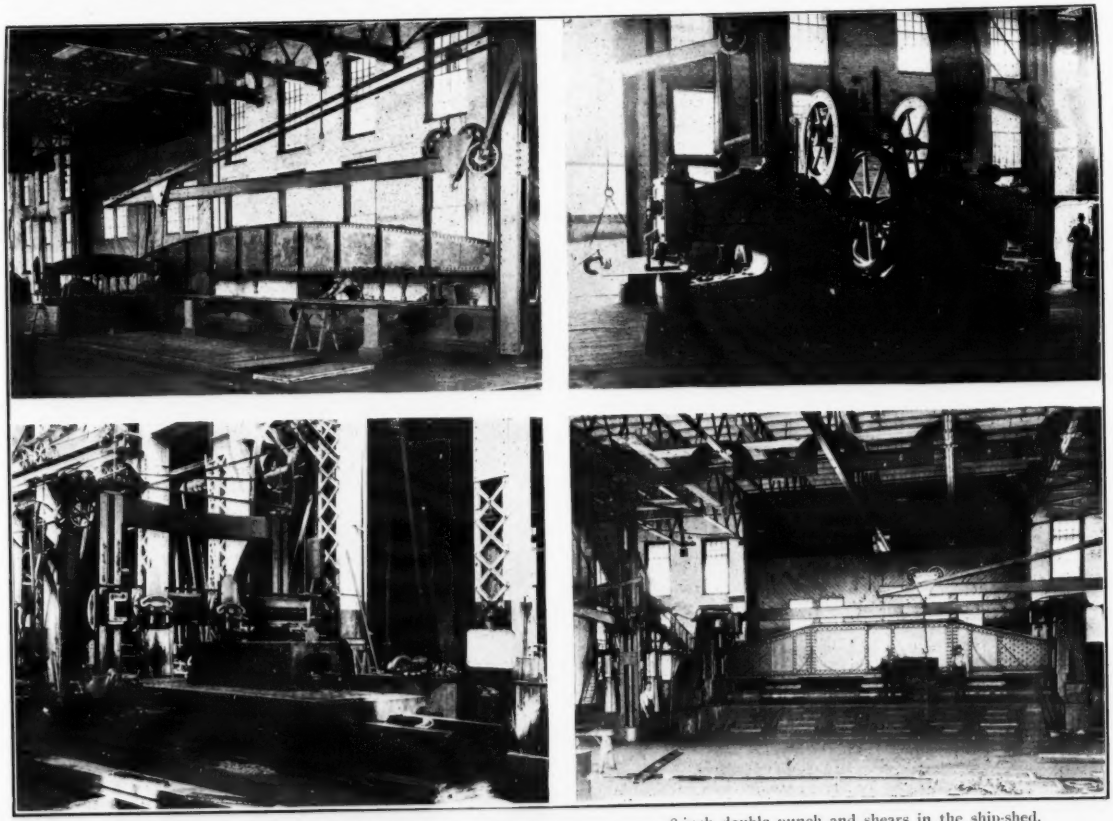
continual increase of the navy—is, indeed, adopting a more extensive naval programme each year, and the apparent falling-off in the amount of naval contracts in the hands of ship-builders is due to the periods at which the compilations of statistics happened to be made, rather than to any policy of retrenchment on the part of the government.

The ship-yards of the United States, unlike a great portion of those in Europe, may be divided into general classes. In the case of the plants on the Atlantic and Pacific coasts, these are four in number. In the first class may be placed the Newport News Shipbuilding & Dry-Dock Co., of Newport News, Va., the William Cramp & Sons Ship and Engine-Building Co., of Philadelphia, Pa., and the Union Iron Works, San Francisco, Cal. These build the largest and heaviest of mercantile and naval tonnage. To the trio enumerated it will be necessary to add, within the year, the New York Ship-Building Co., which is erecting a very pretentious plant at Camden, N. J., the Eastern Ship-Building Co., of New London, Conn., and possibly one or two other new concerns if the projects are carried out as contemplated.

In the second class may be placed those ship-building companies which, to a certain extent, make a specialty of the construction of cruisers, monitors, torpedo craft, and other naval vessels of the intermediate class. In passing, too, it may be noted that several of these institutions are so rapidly extending the magnitude of their operations as to suggest the probability that they will ere long be entitled to places with the first-mentioned yards.

The third class of coast yards is made up of those which, while handling an occasional torpedo-boat contract, are devoted principally to mercantile craft, notably passenger and freight steamers for coasting service, and other similar vessels. Some of these plants also make a specialty of high-class steam-yacht construction, and particularly has a tendency in this direction been manifest during the past few years. In the final class might be listed all of the smaller plants.

On the inland rivers, there are practically but two classes of ship yards—those which in the operations are confined to the construction of wooden vessels, and those which turn out both steel and wooden hulls. On the great lakes, also, a general division separates the yards into two general classes. In the plants of the one are constructed the large freight and passenger steamers ranging from 300 to 500 feet in length, while in the yards of lesser importance there is the same wide range of work that is found in the plants of corresponding size on the coasts. Among the builders of large vessels on the lakes, not a single firm devotes its attention exclusively to wooden construction.



32-foot plate-planer in the ship-shed.
20-foot planer in the machine shop.
48-inch double punch and shears in the ship-shed.
30-foot hydraulic bending rolls in the ship-shed.

LARGE TOOLS IN THE NEWPORT NEWS SHIPBUILDING AND DRY-DOCK COMPANY'S YARD.

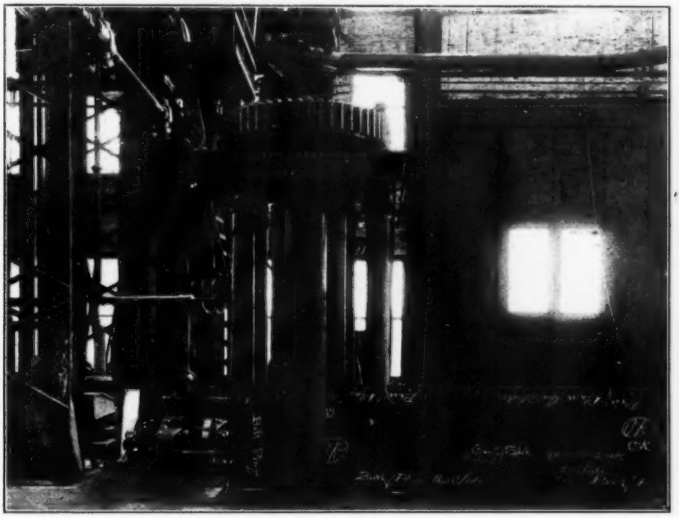
The plant of the Newport News Shipbuilding & Dry-Dock Company is one which has attracted a considerable degree of attention during recent years, by reason of the policy of the management to carry out the most approved modern practice in the matter of equipment and its efforts to devise means to expedite the handling of material in every way possible. The ship-yard, which is located on Hampton Roads—one of the finest natural harbors in the world—covers an area of 120 acres with a mile of water front, and represents an expenditure of $12,000,000. Although the Newport News yard is unrivaled anywhere in the world in the matter of convenience, speed, and economy in the conduct of its operations, the fundamental plan is simple in the extreme. It is based on a continuous, unretarded movement forward of the material from the time it enters the yard in the raw state until it is ready to leave as a part of a completed ship. To this end the various buildings have been grouped in accordance with a carefully-devised plan. The ship and framing sheds and other departmental buildings are located near the stocks where the new vessels are under construction, and thus the material destined for the hull department may be transferred by short hauls. The machine, blacksmith, boiler, and joiner shops form another group, facilitating the handling of material for the department of boilers and machinery.

To go into detail regarding either the buildings or the machinery equipment of the Newport News works is out of the question, although both are deserving of mention. The former are substantial, and they are sufficiently commodious to enable nearly all of the 6,000 employees of the plant to be kept busy under cover in inclement weather, although this is rare in the climate. In the framing shed is a hydraulic manhole punching machine which is accounted the heaviest of the type in the United States. With a pressure of 1,500 pounds it punches a manhole 18 by 27 inches in size, from plates fully ¾ of an inch in thickness. In the grinding room are eight emery wheels, ranging in size from 9 to 36 inches. There are, in the ship shed, 32-foot bending rolls, driven by a 50-horse-power engine and regulated by hydraulic power, which are the largest in the world. The blacksmith shop has more than a dozen steam hammers, ranging from 600 to 2,500 pounds, and one of the heaviest cutting shears ever made, the maximum dimension of cut being 4 inches.

The machine shop alone, a three-story structure about 500 feet in length by 100 feet in breadth, contains an equipment of machine tools which represents a surprisingly heavy investment. There are 36- 60- and 84-inch planers, and a wall planer, measuring 22 feet plane by 22

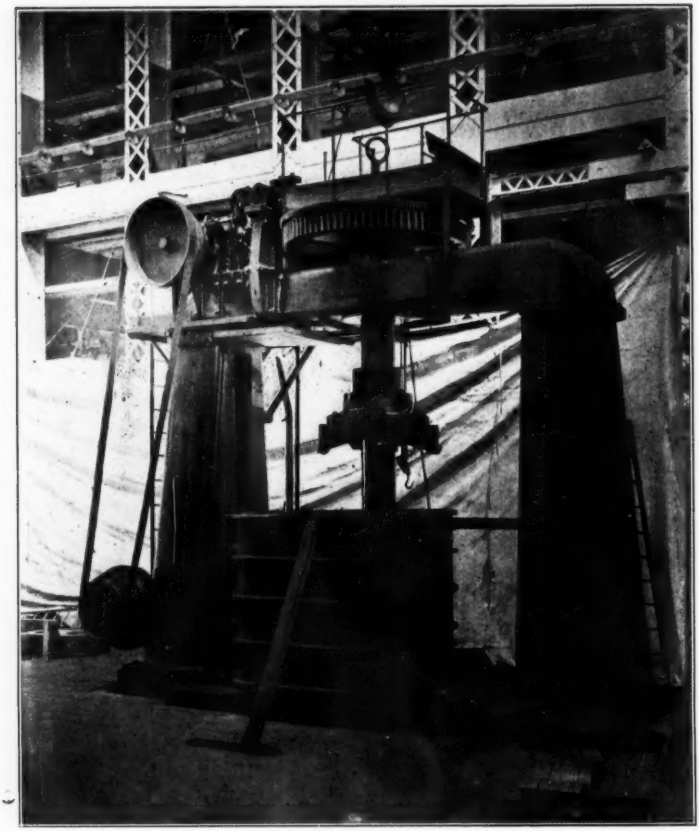
feet slot, which has no parallel anywhere in the world. This machine, which is a combined planer and slotter, is operated by an electric motor of 50 horse-power. A 125-inch shafting lathe will take 34 feet between the centers and has a swing of 125 inches, and a 63-inch lathe, also included in the equipment, takes in a shaft 75 feet long. In the machine shop are electric traveling cranes of 40 and 50 tons' capacity, respectively, and a number of 5-ton hydraulic cranes on piers.

Included in the machinery installation at the main power-house are two air compressors of 350 horse-power each, for driving the very complete equipment of pneumatic tools with which the yard is sup-



10-FOOT ROLLS IN THE BOILER SHOP OF THE NEWPORT NEWS YARDS.

plied, and three 600 kilowatt generators driven by three vertical cross-compound engines, two 125 kilowatt generators driven by one horizontal tandem-compound engine, and two 75 kilowatt generators driven by simple engines. This electrical outfit furnishes sufficient power for running all of the yard shops, in which the old steam engines have recently been replaced by electric motors, furnishes current for the 2,500 incandescent and 150 arc lights which comprise the lighting plant of the yard, and also furnishes power for driving the large centrifugal pumps for emptying No. 2 dry dock. Other machines in the power house are two annealing machines of 30 horse-power each for annealing armor plate, and one 60-horse-power annealing machine,



110-INCH BORING MILL IN THE MACHINE SHOP OF THE NEWPORT NEWS SHIPBUILDING AND DRY-DOCK COMPANY.

together with two 150-horse-power electric generators for supplying power for the operation of the revolving derrick, of which mention will be made later. The steam plant of four large Scotch boilers, arranged in two batteries, each on an independent stack, not only generates steam for use at the main power house, but also supplies the small independent engines installed in various departments for the operation of special machines. This steam is conveyed through an iron subway about 8 feet in diameter and 600 feet in length.

The yard is provided with two dry-docks, the smaller of which is

610 feet long and 130 feet wide on top, 50 feet wide at bottom, with a draft of water over sill of 25 feet; and the larger one, which is now nearing completion, is 827 feet long and 162 feet wide on top, 80 feet wide at bottom, with a draft of water over sill of 30 feet.

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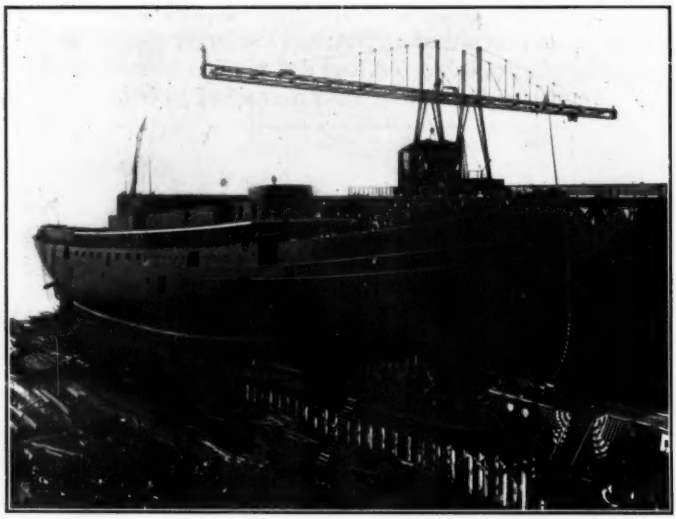
THE 150-TON ELECTRICALLY-OPERATED REVOLVING DERRICK HERCULES.

Newport News Shipbuilding and Dry-Dock Co.

The lumber department of the Newport News yards is probably the most complete in the world. There are single sheds with a capacity of 500,000 feet of lumber, and the entire lumber yard covers an area 500 by 900 feet. There is usually stored here between 4,000,000 and 5,000,000 feet of lumber, embracing thirty-six different kinds and ranging in value from $100 to $500 per 1,000 feet. Connected with the lumber department is a fire-proofing plant with five kilns. The lumber is handled in the yard by a 7-ton locomotive crane. Most of the steel and other material arriving at the yard is handled by a 5-ton crane of the same type. It may be mentioned, in passing, that all metal in storage in the yard is racked to prevent rust.

In view of the attention which the management has given to the question of the handling of material, it is quite natural that the equipment of derricks and cranes should constitute one of the most interesting features of the Newport News yard. First place must be given, of course, to the 150-ton revolving derrick Hercules. The derrick jib is capable of having its outer end raised or lowered, thus giving to the hoisting blocks, which depend vertically therefrom, a movement of



ONE OF THE TRAVELING CANTILEVER CRANES AT NEWPORT NEWS.

rotation about the center of the derrick, and also one of translation in and out from the center. With the outer end of the jib in its lowest position the hoisting blocks will, on rotation of the derrick, describe the circumference of a circle 207 feet in diameter; with the jib in its highest position, the diameter of the circle described is 88 feet. Thus the derrick may operate on weights lying anywhere between these two circles as boundaries. The maximum load of 150 tons can be handled only within a ring the maximum and minimum diameters of which are 147 and 88 feet respectively, but weights not exceeding 70 tons may be handled throughout the entire field of operations. The maximum elevations above mean high water, for the hoisting blocks, are 118 and 69 feet respectively in the high and lower positions of the jib. The derrick is revolved by duplicate sets of machinery.

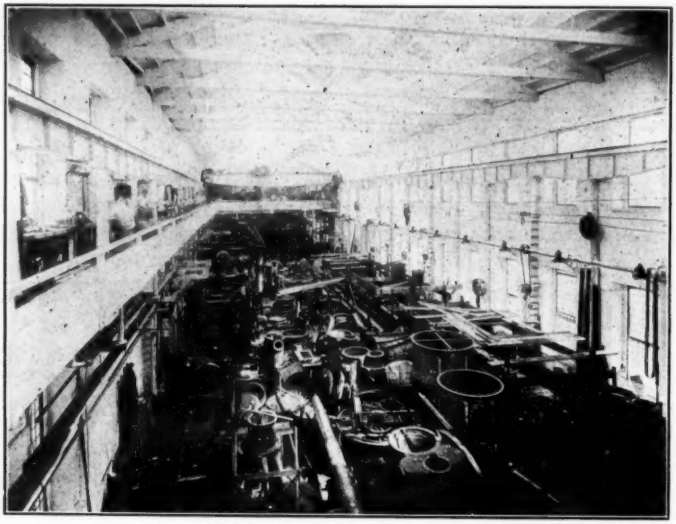
The Newport News yard is probably better equipped than any other single plant in the world with steam- and electrically-operated ship-building cantilever cranes. All of the five large cranes of this type have the same plan of operation. Between each pair of ship-ways is a high trestle, upon a track on top of which is mounted one of the cranes. The horizontal boom of the crane is high enough above the ship-ways to pass over the highest point of the ships being built, while the arms of the cantilever project over the full width of the ship

on each side of the trestle. On the cantilever of the crane is a trolley and hoist block, whereby the load can be hoisted from the ground and traversed from one end of the cantilever to the other. Thus, inasmuch as the crane travels up and down the trestle, the entire length and width of the two ships are covered and materials may be handled and delivered to any part of the ships under construction. Each of the more recently constructed cranes has a tramway 187 feet in length, and the working loads range from 4½ tons 89 feet from the center to 14 tons 55 feet from the center. The trolley will attain any speed desired on the tramway, while the crane is capable of traveling along the track at a speed of 750 feet per minute.

The plant of the William Cramp & Sons' Ship- and Engine-Building Company at Philadelphia, as the pioneer among the larger American ship-yards and the scene of the construction of many of the more important vessels of the "new navy," is easily one of the best known institutions of the kind on the continent. The extensive improvement and enlargement of the Cramp yard, which has been in progress for a year or two and which will require fully a year more for its completion will, however, change the plant almost beyond recognition. Some idea of the magnitude of this undertaking may be gained from the fact that whereas the old yard contained but 30 acres, the new will embrace an area of about 50. Two new slips 700 feet long have recently been completed and are now occupied by the largest hulls ever built in the United States.

THE MASSACHUSETTS, INDIANA, AND PIRATE ON THE STOCKS AT THE CRAMP COMPANY'S YARD.

At present almost all the in-door work at the Cramp yard is performed in one range of buildings, 1,164 feet in length. In this are included the joiner, pattern, machine, and erecting shops, the ship-shed, two mold lofts, and the bending shed. The new buildings now under way or recently completed include a machine shop, blacksmith shop, structures for punches, shears, and rolls, and a power-house from which will be supplied electrical current for both power and lighting purposes. It is the plan eventually to displace with electric motors almost all the engines for the operation of individual machines throughout the yard. There is an apportionment of space in the new power-house for various kinds of pumps, including those for fire protection and for the air compressors supplying the equipment of pneumatic appliances. The equipment of pneumatic



INTERIOR OF THE MACHINE SHOP, WILLIAM CRAMP & SONS' SHIP AND ENGINE-BUILDING CO., PHILADELPHIA, PA.

appliances at the Cramp yard is very similar to that at the other first-class American yards. Power for the hammers and drills is furnished by a 2½-inch main. The usual practice at the large yards is to employ the single-squeeze pneumatic riveter for work in the frame sheds on bulkheads and reverse frames, while for general work preference is usually given to a see-saw arrangement consisting of a beam supporting the riveter at one end with a counter-balance at the other.

The new machine shop of the Cramp Company is 335 by 143 feet, of steel-skeleton framework construction. The floor load in the second story is 400 pounds per square foot, while the third floor is designed for a load of 350 pounds per square foot. The structure has a main central traveling-crane runway, served by two 50-ton electric cranes, with a span of about 57 feet center to center of supporting girders. On either side of the main central portion are machine-shop

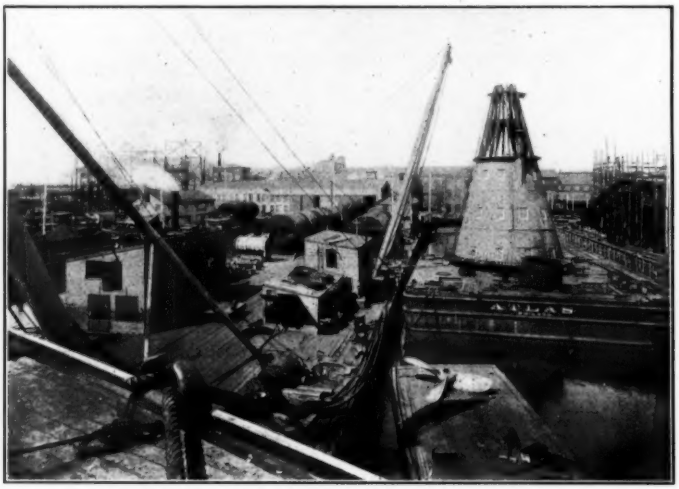
BOILERS AND CONDENSERS IN THE CRAMP COMPANY'S YARDS.

galleries, having a width of 42 feet. The floor space in the lower story of both wings is served by electric cranes from 10 to 30 tons capacity.

In considering the crane and derrick equipment of the Cramp yard, the foremost place must be given to the Atlas, the largest and most powerful floating derrick in the world. The pontoon of the structure is 73 feet in length, 62 feet in width, and 13 feet in depth. When carrying the maximum load of 125 tons at the boom end, and with water ballast aft sufficient to bring her to an even keel, the Atlas has a freeboard of 16 inches and a displacement of 1,563 tons. The cone has a diameter of 40 feet at the base; the length of boom from the axis is 58½ feet, and the boom swings 36 feet clear of the pontoon. The height from deck to masthead is 116 feet and from deck to boom 65 feet. The maximum hoisting height is 50 feet. The pontoon is of iron, while the boom and mast and all lifting and traversing gear are of steel. The yard is provided with three electric traveling cantilever cranes of the same type described in connection with the mention of the Newport News plant. The cantilevers range from 140

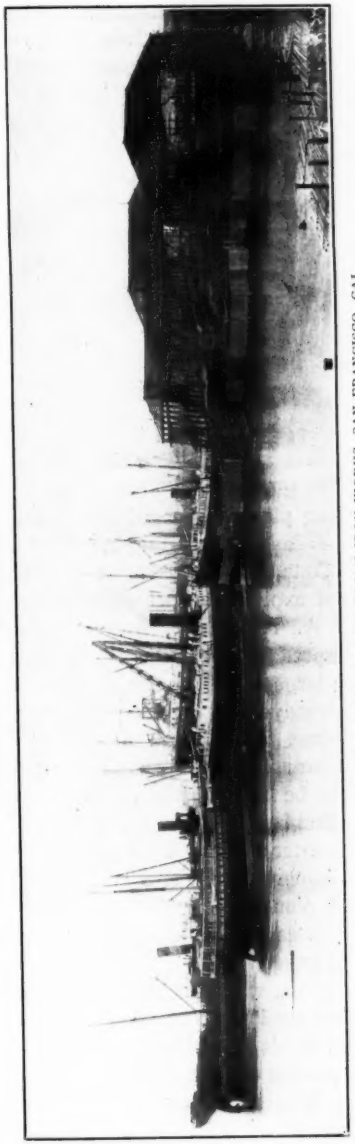
to 200 feet in length. All three are mounted on steel trestles of special design.

The largest ship-building plant on the Pacific coast is that of the Union Iron Works, and it is in many respects the embodiment of the best and most progressive ideas. The yard embraces, all told, about 30 acres, and includes 7 building slips, the arrangement of which in so far as the handling of material is concerned is admirable. Vessels are constructed at this yard under framework sheds of the character of those in use at the plant of Swan & Hunter and other British yards. All of the sheds at the San Francisco yard are of wood, three having a length of 300 feet each and the fourth a length of 468 feet, with



IN THE YARDS OF THE WILLIAM CRAMP & SONS' SHIP AND ENGINE-BUILDING CO., PHILADELPHIA, PA.

crane at each end of 25 foot swing, making the total length of crane-covered space 500 feet. The width is 85 feet and the height varies from 72 to 84 feet. Electric cranes are provided at both ends of each shed. These conveyors travel fore-and-aft at the rate of 180 feet per minute and crosswise at a speed of 90 feet per minute. The lifting capacity is five tons and the speed 90 feet per minute. The Union works is also provided with a hydraulic lifting dock of exceptional interest. The keel blocks are carried on a platform 435 feet in length and 62 feet in breadth, and the lifting operation is performed by hydraulic rams on each side. The dock is capable of lifting 6,000 tons to a height of 32 feet.

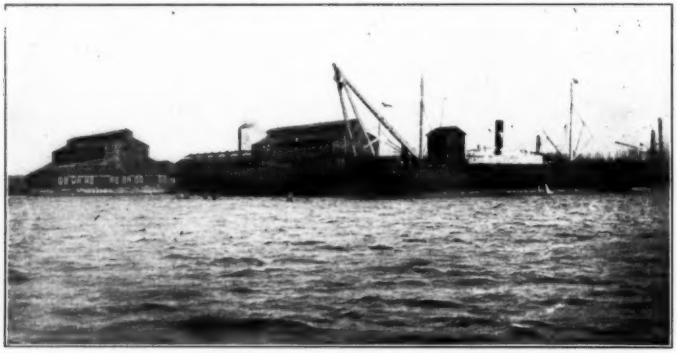


WATER FRONT OF THE UNION IRON WORKS, SAN FRANCISCO, CAL.

The plant has also a hydraulic bending machine for bending plates up to 4 inches in thickness. The machine bends the plate cold, to any shape—conical, cylindrical, or spiral, to suit any part of the ship. This is probably peculiar to this yard. It has also a boring mill, for turning off turrets and fitting the turret rings to the ship, which turns up to 30 feet in diameter. It is believed that this yard is the only one in America making the turret rings (26 feet in diameter), in a single piece.

The plant of the New York Ship-Building Co., at Camden, N. J., upon the installation of which work was commenced in the summer of 1899, will cost when completed more than $6,000,000 and will be entitled to rank with any of the yards previously mentioned. The company owns a tract of 120 acres and the yard has a frontage of 3,500 feet on the Delaware River, there being a depth of 40 feet of water along the entire front at low tide. Perhaps the best idea of the magnitude of the yard may be conveyed by the statement that the six largest buildings will be respectively of the following dimensions: 92 by 180 feet, 156 by 557 feet, 184 by 557 feet, 412 by 940 feet, 50 by 100 feet, and 115 by 130 feet. There are, in addition, a number of wooden buildings. The New

York company will build the major part of its vessels under framework shelters similar to those at the yard of the Union Iron Works at San Francisco and thus, for the time being at least, no traveling cantilever cranes will be introduced.



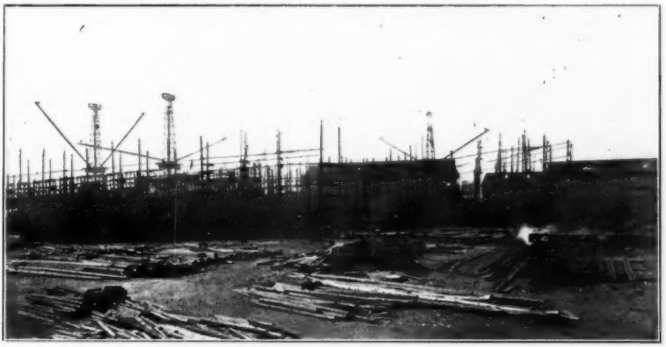
YARDS OF THE MARYLAND STEEL COMPANY, SPARROW'S POINT, MARYLAND.

Among the other new ship-building plants of magnitude now in process of formation is the yard of the Eastern Ship-Building Co., on the Thames River at New London, Conn. Connected with the new institution are several ship-builders of experience, including Messrs. Charles R. Hanscom and William A. Fairburn, formerly superintendent and naval architect, respectively, of the Bath Iron Works, of Bath, Me. Vessels of the largest size, merchant and war, will be built. Indeed, the company already holds the contract for the construction of two vessels for President James J. Hill of the Great Northern Railway, which will be the largest in the world. These vessels, which will cost $5,000,000, are to be built for the Pacific trade. They will be 650 feet in length by 73 feet beam, with seven decks, and it is asserted that they will have a greater tonnage than any vessels heretofore built or projected. Other important new ship-yards are in contemplation, including a $1,000,000 plant at New Orleans and an extensive yard near New York City, but as yet they can none of them be said to have passed the preliminary stage.

A couple of ship-building plants which, while possibly in the secondary class at present, may be expected ere long to take rank with the most prominent firms, are found in the yards of the William R. Trigg Company at Richmond, Va., and the marine department of the Maryland Steel Co., at Sparrow's Point, Md. Both may rightfully be classed as new plants. The yard of the Maryland company was, it is

true, originally established years ago; but not only had it been out of operation for a long period prior to the autumn of 1898, but the management has, in the interval which has elapsed since the yard was reopened, so modernized the equipment as to give the plant the semblance of an entirely new institution.

The Sparrow's Point yard employs regularly about 800 men, and some important work is under way there, including the steel floating dry-dock under construction for the United States government—the largest in the world. The equipment of the yard includes a complete outfit of pneumatic tools and some machine tools of very fair capacity. Probably the most interesting feature of the equipment, however, because the most unique, is a type of locomotive derrick, designed and built at the Maryland company's works. There are a number of these derricks in the yard. The idea of the apparatus is to raise the ship plates from the ground, instead of lowering them from above as is done at the Newport News and other yards where traveling cantilevers propelled by electricity or steam are employed. In the principle of operation on standard-gauge track, the derrick corresponds to the regulation type of locomotive crane, utilized in all ship-yards for the handling of material; but instead of being mounted on the ordinary type of flat car, the apparatus in this case is operated from the top of a steel derrick which permits of 10 tons or even more being raised to a height of 60 or 70 feet. The arrangement of the Sparrow's Point



MARINE DEPARTMENT, MARYLAND STEEL CO., AT SPARROW'S POINT, MARYLAND.
Showing the novel type of derricks used at these yards.

yard is such as to facilitate economy of time. The machine, boiler, and joiner shops form one group of buildings, and the bending and ship-fitting sheds and other similar departments another.

The circumstances surrounding the establishment of the yard of

PLANT OF THE WILLIAM TRIGG COMPANY, RICHMOND, VA.

the William R. Trigg Company, of Richmond, Va., illustrate what may be accomplished when the proverbial American energy is carried into ship-building. In the summer of 1898 Mr. Wm. R. Trigg submitted bids for the construction of several torpedo boats and destroyers. At that time Mr. Trigg held an option upon the plant of the Virginia Machine Company, and upon several acres of property situated upon the Richmond docks.

In the face of some opposition, based upon the fact that he had no established organization, he was awarded the contract for three torpedo boats and two torpedo-boat destroyers. Within sixty days from the date of the award the Trigg Company had been organized and had in operation a plant employing 200 men, and at this time over 800 men are employed. The company has been so successful that it has purchased 25 acres of land lying between the dock and the river, and has begun the erection of a dozen large buildings. The machinery equipment is in accordance with the latest modern practice. The three torpedo boats have been launched and the company now has contracts for the cruiser Galveston, of the Denver class, two revenue cutters, two steamboats, and is rebuilding the sub-marine torpedo boat Plunger. The Trigg yard has at present but one limitation—the draught of water in the James River. When the channel is dredged to 25 or 28 feet, there is no reason why the Trigg company should not build the heaviest ships used by the Government.

(To be continued.)

THE COMMERCIAL ORGANIZATION OF THE MACHINE SHOP.

By Hugo Diemer.

II.—THE PRODUCTION DEPARTMENT—BILLS OF MATERIAL.

IN many establishments there is no one outside of the drafting department who has at hand any data showing the distinct separate items required to make up a complete machine. In order to facilitate prompt manufacture, it is important that there be some person whose duty it is to see that, without overstocking, sufficient material is on hand to complete all orders with the least possible delay. This person must be so familiar with methods of manufacture that, with the guidance of the data furnished him by the drafting department as hereafter mentioned, he will be able to order all material which needs to be bought from outside sources. He must also be competent to provide a necessary stock of such finished parts as must be carried in the stock-room, besides providing a sufficiency of tools and patterns. He must be able to judge when pressure of orders requires a duplication of tools and patterns, without going to unnecessary expense in this regard. All orders for such extra tools and patterns, of course, pass through the general superintendent's hands for approval before being issued to the shop.

As soon as the drafting department has received its shop order, it prepares three lists for the bill of material clerk, viz.:

(1) The Drawing List.

(2) The Pattern List.

(3) The Tool List.

The drawing list gives the numbers of all drawings required in the manufacture of the machine. The pattern list gives the numbers of all patterns, together with corresponding drawing numbers, and the tool list gives a similar list of tool numbers and corresponding drawing numbers, these lists covering all patterns and tools required in the manufacture of the machine.

If the machine is a standard one, which has already been built, the preparation of the bill of material and the following up of material, patterns, and tools is a comparatively simple matter. But it is a less

Professor Diemer's articles began in the issue of THE ENGINEERING MAGAZINE for June, 1900. The first of the series was "The Systematized Classification of Shop Orders."

easy task to push through a new machine in which part, or perhaps all, of the drawings and patterns and many tools will be new ones.

A good plan is to mark with a rubber stamp "Complete," those drawing-, tool-, and pattern-lists to which there will be no further additions. The reason for this is that it is frequently desirable that the bill-of-material clerk should receive the lists before they are entirely complete, so that he may begin ordering material. The lists thus sent in will, of course, contain only such drawings as are certain to be used, nothing doubtful being inserted. The bill-of-material clerk returns these incomplete lists to the drafting room as soon as he has ordered as much material as possible, retaining the lists permanently only when they are marked "complete." It is, of course, far preferable not to begin work until all the data are complete, because there is always a possibility of changes being necessitated as the machine develops. The circumstances of each particular order will determine whether or not it will be necessary to send in incomplete lists to the bill-of-material clerk.

The material clerk needs to be provided with a set of all drawings, so that he may have access to them at all times without interfering with the work of the drafting or designing departments. It is apparent that it is very advantageous, from the standpoint of convenience and rapidity to the clerical force, to have drawings of a uniform size, sufficiently small to be handled and filed with ease. It is always desirable to make drawings in this way where it will not sacrifice shop accuracy or economy. It is easier than one would first suppose, however, for a shop to adapt itself to drawings of small size. A prominent electrical factory does more accurate work at the present time from drawings uniformly 10 inches by 14 inches than was done in the same shop five years ago from full-size drawings. Small drawings of a uniform size possess the advantage that they may be easily bound with fasteners into sets of one hundred and conveniently kept in a pigeonhole case for reference.

When the bill-of-material clerk receives his lists from the drafting-room he begins at once to make out his bills of material. In some factories these material lists are called "specification sheets," but a bill of material is not a specification, hence I believe the term "bill of material" or "material list" is preferable.

Where but one general store-room is used in a shop, a single bill of material will suffice. Where there are distinct stock-rooms for different sections or departments of a factory, and a machine needs to pass through several such departments, it is needless for any one depart-

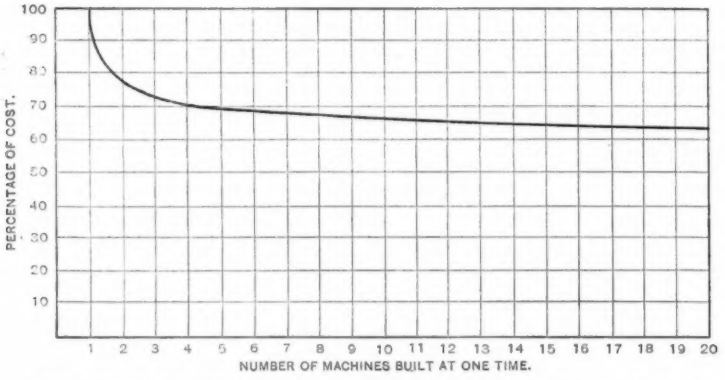
ment to have a complete bill of material, it being sufficient to supply each department with a list of all material which it needs for the completion of its work on the order.

The bill of material can be made extremely useful for three distinct purposes: First, it serves as a record of the time of ordering and receiving material needed; second, it may be used in drawing material from the stock-room; third, it may be used as a record of material actually drawn as compared with material specified, thus affording reliable data for the cost department.

The normal condition of a successful shop is that it is full of work for some time ahead. Orders for standard machines are coming in in a constant stream. In certain lines of manufacture the variety of machines demanded prohibits the extensive issuing of stock orders. In such cases, if the shop is full of work, it is well to refrain from issuing formal orders when it is certain that no action on them can be taken in the shop for some days to come. It is best to wait some days and then be able to issue one shop order covering two, three, or four machines of a kind, instead of having separate orders for like machines stringing along singly. Where the latter plan is followed, the question which machine is which is almost certain to cause confusion and loss of time. Men charging up their labor on time tickets, or drawing material from store-rooms, will have to spend more time in looking up the separate order numbers than if all the machines were built on one shop order. If a number of similar machines are simultaneously built on separate orders, the cost department will frequently find a wide variation in cost of labor, one machine being absurdly low and another absurdly high; nothing remains but to "lump" them. This means going over all the labor on each machine separately, adding all together, averaging, and redistributing, thus making a "doctored" record.

A comparison of cost records covering several years has convinced me of a marked saving in building two machines of a kind at once, over their cost if built singly. Where a duplicate machine is at all likely to be available stock, it is far best to make one. The saving in cost of labor does not increase directly with the number of machines built at one time, however. The accompanying curve, which will be found in the diagram on the following page, indicates the results of comparisons of costs of labor on several hundred electrical generators and motors. The abscissæ represent the number of machines built simultaneously; the ordinates, the relative cost. The cost of one machine built by itself was taken as 100 per cent. Then the

percentage of this cost was taken when two or more machines of a kind were built. The reduction to percentage made the curve a general one, applicable to all sizes of machines. It will be noted that there



CURVE SHOWING REDUCTION IN COST BY BUILDING SEVERAL MACHINES AT ONE TIME.

is a marked drop when two machines are built at once, but that after that the fall is very gradual.

In addition to the internal economy, there will be a saving of labor to the clerical force by simultaneous manufacture or "bunching" of several shipping orders into one shop order. In addition to this, the issuing of but one bill of material will effect a saving of drayage, freight, and handling on castings and other items which would string along separately if separate bills of material were issued for each shipping order.

Every piece should have a concrete name by which it will be known, as well as its pattern number. This naming will be found useful, not only for prompt identification of parts in the shop and stockroom, but also in making up price lists of repair parts.

In order to illustrate the uses of the bill of material I append extracts from a bill of material for an engine lathe, also part of a bill covering the work on the armature of an electrical generator or motor in the winding and insulating department.

The first column, headed "Material," states whether the piece is made of cast iron, cast steel, wrought iron, malleable iron, tool steel, cast copper, cast brass, brass rod, copper rod, etc., suitable abbreviations being used, such as c. i. for cast iron, etc. At one time I sought to simplify matters by printing the names of certain pieces that were to be made of cast iron in a certain kind of type, and using different

BILL OF MATERIAL

SECTION.....

Shop Order No..... *Date*.....

.....*Machines.* *Type*.....

To be completed.....

Remarks.....

WINDING AND INSULATING DEPARTMENT.

ARMATURE.	Material.	Size or Pattern No.	Drawing No.	Quantity Required.	Date Ordered.	Date Received.	Material Drawn from Store Room.	Total Weight.	Cost, Material.	Cost, Labor.
Copper Wire.....										
" "										
" "										
Copper Strip.....										
" "										
Mica.....										
Thin Press Paper.....										
Thick Press Paper.....										
Cardboard.....										
"										
Micanite Cloth.....										
Empire Cloth.....										
Stay Binding.....										
Tape.....										
Cord.....										
Duck.....										
Solder.....										
Linen.....										
Twine.....										
Cotton Tubing.....										
Wood Strips.....										
Brass Wire.....										
Soldering Compound...										

BILL OF MATERIAL.

SECTION.....

Shop Order No..... *Date*.....

.....*Machines.* *Type*.....

To be completed.....

Remarks.....

	Material.	Size or Pattern No.	Drawing No.	Quantity Required.	Date Ordered.	Date Received.	Material Drawn from Store Room.	Total Weight.	Cost, Material.	Cost, Labor.
Bed										
Right-Hand Leg										
Left-Hand Leg										
Lower Portion of Tail Stock										
Upper Portion of Tail Stock										
Tail-Stock Spindle										
Hand Wheel for Tail Stock										
Tail-Stock Spindle Screw										
Lever for Clamping Tail-Stock Spindle										
Washer for Clamping Lever										
Bolt for Fastening Tail Stock to Bed										
Nut for Same										
Drifting Screw for Tail Stock										
Tail-Stock Sleeve										
Head-Stock Casting										
Head-Stock Spindle										

kinds of type for brass and copper pieces, and so on. But it soon developed that pieces known by the same name might at various times and under varying conditions be made of different materials, sometimes of cast iron, sometimes of malleable iron, and sometimes of brass, so the idea of separate type was dropped, the column headed "Material" being used for this purpose. The second column is headed "Size or Pattern Number." Where the piece is one cut out of rod metal, the size of the rod is given—such as ¾-inch round, or 1 inch by 1½ inch; if a casting, the pattern number is inserted. The next column is headed "Quantity Required." The next is headed "Drawing Number," and the following two columns "Date Ordered" and "Date Received," respectively. If the material is in stock, the words "in stock" are written across these two columns. It is the business of the bill-of-material clerk to keep in touch with the purchasing department, following up all castings and other special material which is noted in the "Date Ordered" column, but which has not yet been received. As soon as the bill of material is completed, the bill-of-material clerk goes to the stock-room and determines what material is in stock and what needs to be ordered. The marking or arrangement of such material as is in stock will be considered under the subject of "Stock-Room Management," as will also the use of the wide column entitled "Material Used." The next column is entitled "Weight." In this column is inserted the weight of all castings and other pieces whose price is figured by weight. In order that the material clerk may properly fill in these columns, headed "Date Received" and "Weight," it is evident that he should receive either the invoice with notation of date received, from the receiving department, or else a list of all goods received. The invoice itself can be made to answer the purposes of a list of material received by the store-room. A pencil list, however, made out with a stub and carbon copies, one set for the purchasing department and one set for the material clerk, has the advantage of being a complete consecutive record, and is easier to refer to than invoices are.

The bills of material may advantageously have holes punched in them so that they may be kept on a prong file, separate file boards being used for bills which are not complete, bills on which all material is in, and bills on which material is still to come in.

The position of bill-of-material clerk is one that can easily be filled by a young man from the drafting department. It is evident that he must be a man who can read drawings and who is familiar with the pieces constituting the machine.

THE SETTLEMENT OF THE MACHINISTS' STRIKE.

THE threatened trouble between employers and employees in the American metal trades, which at one time seemed likely to bring on an industrial war more disastrous than that which distressed the English engineering world in 1897, have reached a settlement that appears to have the elements of endurance and stability.

It is strong because it is based upon justice, fairness, and reason—upon principle, not merely upon expediency. The happy results of an honest and open-minded effort to arrive at a "mutual understanding of one another's views and of the approaches by which they have been reached," for which THE ENGINEERING MAGAZINE has been a constant and earnest advocate, are clearly apparent in the agreement which is given herewith in full, except in so far as it covers a special settlement of local labour troubles in Paterson.

And yet another most gratifying circumstance attending it is that it comes, instead of, and not as the result of, a long, bitter, and mutually exhausting struggle. The lessons of the industrial peace which England bought so dearly two and a half years ago have been studied by manufacturers and workmen; echoes of the agreement between the Employers' Federation of Engineering Associations and the Amalgamated Society of Engineers sound through the resolutions of settlement unanimously adopted by the National Metal Trades' Association and the International Association of Machinists. That this is attributable in large part to the growth of foreign trade there can be no doubt. Practice and experience are alike becoming international possessions.

While the New York settlement does not directly touch upon piece-work, minimum wage, or the handy man, it establishes a precedent of wise, temperate, and common-sense agreement which is the best and more certain assurance against future discord. Indeed, with these two great instances, English and American, of the adjustment of labour troubles by arbitration, and of the permanent establishment of organisations powerful enough to assure the fulfilment of their

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Preceding articles upon this topic in THE ENGINEERING MAGAZINE have been:

Labour Questions in England and America. Charles Buxton Going. May, 1900.
Manufacturers' Associations, Labour Organizations and Arbitration. H. W. Hoyt. May, 1900.
New Shop Methods a Corollary of Modern Machinery. Editorial. June, 1900.
Piece Work Not Essential to Best Results in the Machine Shop. James O'Connell. June, 1900.

agreement, wise and tolerant in their efforts to understand one another's attitude, and moved by reason and justice in framing their own demands, the whole industrial world has moved a long way toward a solution of the labour problem. The millenium is not yet—witness the outrages of the situation in St. Louis. The wisdom of the leaders may not always be recognised nor their agreements loyally observed by the rank and file. The labour union, in its present form, is not a very responsible organisation, and shows a tendency to profit by its intangibility too often to establish a very strong feeling of confidence.

The agreement is thus set forth:

"The resolutions as adopted were adopted in the order as here presented, and become binding upon all members of the National Metal Trades' Association and the International Association of Machinists. The official act of this joint conference establishes a precedent for national arbitration as called for under what is known as the Chicago Agreement of March 17th, accepted and signed by both parties March 31st. The hearing has been harmonious, and the decisions arrived at satisfactory alike to both parties.

*"The Board of Arbitrators representing the International Association of Machinists during this conference had by wire and telephone as an advisory board members of the local organizations throughout the United States. The arbitrators on behalf of the National Metal Trades' Association had with them as an advisory board the Administrative Council and other members of their Association from various parts of the United States. During the entire session on recess or adjournment the respective boards of the conference committee met with the boards of their respective organizations for consultation.

*"It should be stated that prior to any matters being taken up for arbitration, the strikes existing in Paterson, N. J., and Cleveland, Ohio, were officially declared off by the International Association of Machinists, represented by their Board of Arbitration in shops that were members of the National Metal Trades' Association, and the members of the National Metal Trades' Association in Cleveland and Paterson were notified by their members on the board of arbitrators that they on their part must comply strictly with the spirit and letter of the Chicago agreement. This being accomplished the arbitrators commenced their session, there being no strikes or lock-outs in any shops in the United States except Cleveland and Paterson. The first two resolutions adopted fully explain the action taken by the arbitrators in connection with Paterson and Cleveland:

* See explanatory note on page 522.

"*Whereas,* conflict between capital and labor has been disastrous alike to each, the International Association of Machinists and the National Metal Trades' Association, appreciating the importance of adopting some measure that would provide against strikes and lockouts in the future, met in joint conference for the purpose of adopting such measures as would be alike just to the employee and the employer. This conference, meeting in New York May 10, was in continuous session until May 19, having formulated a code by a series of resolutions, which for the first time established the value of national arbitration, and by their act has, it is believed, made history which will benefit all other like organizations.

*"*Resolved*: That the strikes be declared off in the factories of the members of the National Metal Trades' Association in the cities of Cleveland and Paterson, the National Metal Trades' Association members of this Board to wire the members of their association in these two cities to meet a committee, from each shop, of their former employees to arrange for the return of as many men as their present necessities require; and that subsequent requirements of men shall be filled from their former employees whom they may not be able to reinstate at the present time.

*"The intent of this last clause is, that if, within the next six months, former employees make application for re-instatement they shall be re-instated, provided there are vacancies for them.

*"Where strikes exist in these cities in firms other than the members of the National Metal Trades' Association, who will agree to the settlement herein entered into, after the same has been adjusted by this joint body, such strikes shall be declared off also.

"*Whereas,* doubts have been expressed by members of this Board, representing both parties to this conference, as to the ability of their respective organizations to control their members;

"*Now, therefore,* be it resolved that the members of this board pledge themselves each to the other that in case of the refusal of any member of the respective organizations represented to observe and carry out in an honorable manner the findings and decisions of this board, in regard to strikes and lockouts, based upon a fair, just and liberal interpretation as to what is known as the Chicago agreement, we will report such member or members to our respective organizations for discipline, suspension or expulsion, as the merits of the case may justify.

"Machinist.—A machinist is classified as a competent general

* See explanatory note on page 522.

workman, competent floor hand, competent lathe hand, competent vise hand, competent planer hand, competent shaper hand, competent milling-machine hand, competent slotting-machine hand, competent die sinker, competent boring-mill hand, competent tool-maker, and competent linotype hand. To be considered a competent hand in either class he shall be able to take any piece of work pertaining to his class, with the drawings or blue prints, and prosecute the work to successful completion within a reasonable time. He shall also have served a regular apprenticeship or have worked at the trade four years.

"It is understood that the question of competency is to be determined by the employers. Since the employers are responsible for the work turned out by their workmen, they shall, therefore, have full discretion to designate the men they consider competent to perform the work, and to determine the conditions under which it shall be prosecuted.

"This last paragraph does not, in any way, abridge or destroy the right of appeal from any apparent or alleged unjust decision rendered by an employer of labor, or his representative, in conformity with the powers vested in him by this paragraph.

"Overtime.—All overtime up to 10 o'clock P. M., shall be paid for at the rate of not less than time and one-quarter time, and all overtime from 10 P. M., until 12 midnight shall be paid for at a rate of time and one-half time, and that after 12 o'clock and legal holidays and Sundays shall be paid for at a rate of not less than double time.

"In cases of emergencies, where shop machinery breaks or runs down, and it is absolutely necessary to repair the same so that the factory can run on Monday, this time shall be paid for at a rate of time and one-half. The repairs above referred to apply only to machinery of the employer.

"The foregoing rates not to interfere in any way with existing conditions; that is, where a higher rate than the above is paid now, no reduction will take place.

"Such rates for overtime shall not apply to men regularly employed on night gangs.

"Apprentices.—There may be one apprentice for the shop, and in addition not more than one apprentice to every five machinists. It is understood that in shops where the ratio is more than the above, that no change shall take place until the ratio has reduced itself to the proper number, by lapse or by the expiration of existing contracts.

* "Employment and Hours.—No discrimination shall be made

* See explanatory note on page 522.

against union men, and every workman shall be free to belong to a trade union, should he see fit. Every employer shall be free to employ any man, whether he belong or not to a trade union. Every workman who elects to work in a shop will be required to work peaceably and harmoniously with all fellow employees, whether he or they belong to a trade union or not. He shall also be free to leave such employment, but no collective action shall be taken until any matter in dispute has been dealt with under the provisions for avoiding disputes as per the Chicago agreement, dated March 17th, 1900, signed March 31st, 1900. The National Metal Trades' Association does not advise its members to object to union workmen or give preference to non-union workmen.

"Fifty-seven hours shall constitute a week's work from and after six months from the date of the final adoption of a joint agreement, and fifty-four hours shall constitute a week's work from and after twelve months from the date of the final adoption of a joint agreement. The hours to be divided as will best suit the convenience of the employer.

*"In consideration of this concession in working hours, the International Association of Machinists will place no restrictions upon the management or production of the shop and will give a fair day's work for a fair day's wage.

"*Note.*—This not to interfere in any way with shops where a less number of hours per week is already in operation."

* NOTE.—The paragraphs marked with an asterisk, though an integral part of the agreement, are omitted from a blank form of "Agreement" which, as this article is written, is being distributed widely, apparently by someone undertaking to act for the machinists. Apparently, also, it is designed for adoption as a shop agreement, as it has spaces for signature by the "firm," and by the local representative of the "I. A. of M." It bears the prefatory heading "Copy of Resolutions Passed and Adopted by the Arbitration Board of the National Metal Trades' Association and the International Association of Machinists, at Murray Hill Hotel, New York, during its Sitting, May 10 to May 18, 1900, the Sitting Being Continuous during this Period of Time." We have, however, official assurance from the International Association of Machinists that no copy of the agreement has been published from their office "other than official circular No. 10," "which is not intended in any way as a basis of agreement between individual firms and their employees." It is, as the copy in our hands clearly shows, merely a general summary of the gains effected by the settlement, as estimated by the machinists. These are, briefly, five: national recognition of their organization; limitation of apprentices; definition of a machinist; shortening of the working day; and adjustment of overtime and the rates to be paid for it.

UTILIZING THE WASTE HEAT FROM THE GAS ENGINE.

By Alton D. Adams.

EXHAUST from steam engines is now generally used for heating purposes, with good results and a great saving of otherwise wasted heat. The rapidly-increasing applications of gas engines render means for the use of their waste heat important, but little seems to have been done thus far toward effecting this end. Lack of greater progress in the utilization of the heat from gas engines is probably due in part to the forms in which this heat is available. Exhaust steam contains substantially all of the heat that can be recovered from steam engines, but at the gas engine heat appears in large amounts under two forms—the jacket water and the exhaust gases. It is a comparatively simple matter to apply exhaust steam in a heating system, but more of a problem to save the heat of the jacket water and gases for useful purposes. If buildings are to be heated by gas engines, it is quite evident at the start that heat distribution can best be effected by air, steam, or hot water in one of the usual ways. Whatever is done as to the distribution of heat must not seriously interfere with the operation or efficiency of the engines, so the effects on exhaust gases and jacket water should be carefully considered. One of the first and most important points to be decided is the amount of heat per hour, or the square feet of radiating surface, or the space that may be heated from a gas engine of given capacity, when working at full load.

The efficiency of gas engines—that is, the ratio of delivered work to the fuel energy of the gas consumed—varies with their size and construction. Inspection of results from a large number of tests, however, seems to indicate that the efficiency and losses, based on the total calorific power of consumed gas, may be fairly assumed as follows for engines of moderate capacity: Efficiency, that is the ratio of delivered brake horse-power hours to the heat energy of the gas consumed, 18 per cent. Losses by conduction and radiation of heat from the engine frame, 5 per cent. Heat escaping in the exhaust gases, 37 per cent.,

One of the most striking manifestations of modern economy is the saving of by-products. In many departments it has revolutionized industrial practice. The choice of means or methods is often determined by the recoverable values in what was formerly waste. This tendency is as strongly manifest in the power-house as it is in the gas works, and Mr. Adams will be followed with interest in his view of the possible economies of the newer forms of motor, and of the practical means for making these economies available.—THE EDITORS.

and in the jacket water 40 per cent. As one horse-power hour of work is the equivalent of 2,545 heat units, the assumed efficiency of 18 per cent. corresponds to an hourly development of $2,545 \div .18 = 14,139$ heat units at the engine for each horse-power hour of output. Of this amount of heat, 37 per cent., or 5,231 heat units, escape in the exhaust gases and 40 per cent., 5,655 heat units, in the jacket water. The sum of these losses, 10,886 heat units, represents the total heat added to the exhaust gases and jacket water, per delivered horse-power hour, but it by no means follows that all of this heat can be recovered to warm buildings. As about one-half of the heat given off by the engine is in the jacket water, it seems at once desirable to add to this water as much as possible of the heat from exhaust gases, so as to combine the two supplies. Such a combination of heat seems practicable from the fact that the temperature of the jacket water is usually much below that of the exhaust gases. The requirements of lubrication hold the temperature of the cylinder, and consequently of the jacket water, at about their present maximum figures, though engine efficiency would be improved by higher values. It is, therefore, desirable to take jacket water at the temperatures now common, and add thereto as much as is practicable of the heat in the exhaust. About 150 degrees Fahrenheit seems to be the present maximum temperature advisable for jacket water on leaving the cylinder. To raise water from 32 degrees to 150 degrees Fahrenheit requires 118 heat units per pound, while 1,028 heat units must be added to each pound of water at 150 degrees, to change it to steam at atmospheric pressure. It therefore seems that only about one-tenth of the jacket water, from a gas engine, can be turned to steam by the entire heat in its exhaust gases, even if all of it can be extracted. Any plan that involved steam heat alone would consequently make use of little more than one-half of the total available heat from the engine. In ordinary cases it hardly seems desirable to make use of both steam and hot-water heating systems, so that an arrangement by which the temperature of the jacket water is raised by the exhaust gases gives the greatest promise of economy.

In a hot-water heating system, operated from a gas engine, the jacket water, after leaving the engine, should pass through pipes that are subject to the action of the exhaust gases. Leaving the gas-heated pipes, the hot-water supply should go to the radiators or other heating surface, and thence back to the water jacket on the engine cylinder. The amount of heat that can be extracted from the exhaust gases by the jacket water, with suitably proportioned heating surface, obviously depends to a large extent on their relative temperatures. There is

much uncertainty about the temperature of gas-engine exhaust, unless all of the conditions of operation are known, but 1,050 degrees Fahrenheit seems to be a conservative estimate for an average case. Experience with economizers indicates that gases of combustion may be reduced in temperature to within 150 degrees of that of the water in the heated tubes at the outgoing end, without too much extension of the heating surfaces. Such a temperature should be selected for the water that leaves the gas-heated coils for the radiating surface, that it will reach the water jacket at a certain point below 150 degrees in temperature. The temperature of water on entering the cylinder jacket should be such, at the maximum rate of flow through the system, that it will be 150 degrees on leaving the jacket. If the exhaust gases are lowered from 1,050 degrees to 350 degrees temperature they give up approximately two-thirds of their heat. As the total heat escaping in the exhaust was taken at 37 per cent. of the calorific power of the gas consumed in the engine, about two-thirds of this, or 24 per cent. of the heat of gas combustion, may be added to the jacket water under the conditions named. With 40 per cent. of the heat from gas combustion in the jacket water before it comes under the action of the exhaust, the contained heat of the water is raised to $40 + 24 = 64$ per cent. of the total amount developed. Of the heat added to the jacket water by the gas engine, the cylinder supplies $40 \div .64 = 62$ per cent. and the exhaust gases 38 per cent. It will now be evident that the difference in temperature of the jacket or circulating water, from the time it reaches the cylinder until it leaves the gas-heated coils, may be varied through considerable limits, according to the design of the heating system. Thus, if the water pipes and radiating surface are so proportioned that the temperature of the circulating water falls 100 degrees, while passing through them, the temperature at the exit from the cylinder jacket being 150 degrees, the water will enter the jacket at $150 - 62 = 88$ degrees and leave the gas-heated coils at $150 + 38 = 188$ degrees, nearly. This result is due to the fact that the amount of heat required to raise one pound of water one degree in temperature at any point between the temperature limits named, corresponds very nearly to the true heat unit. If the range of temperature drop in the circulating water between the pipes to the radiating surface and those that return water to the cylinder jacket is only 40 degrees, then the rise of temperature in the water jacket, under the conditions named, is $40 \times .62 = 25$ degrees and the rise in the gas-heated coil 15 degrees. In this last case the circulating water enters the cylinder jacket at $150 - 25 = 125$ degrees and leaves the gas-heated coils at $150 + 15 = 165$

degrees. The objection to a large drop in the temperature of circulating water is the resulting low average temperature of the radiating surface and the increased amount necessary for a given work.

Allow each square foot of first-class, direct-radiating surface to dissipate two heat units per hour, for each degree difference in temperature between the water or radiating surface and the air, and a drop of forty degrees in the temperature of the circulating water in the radiator. This gives the radiator an average temperature of $(125 + 165) \div 2 = 145$ degrees, and allowing a room temperature of 70 degrees, each square foot of radiating surface dissipates $(145 - 70)2 = 150$ heat units per hour. In a regular hot-water heating system, designed, as is often the case, for a drop of temperature in the radiators from 210 to 190 degrees, the average temperature of the radiator is $(210 + 190) \div 2 = 200$ degrees, and the heat from each square foot per hour is $(200 - 70) \times 2 = 260$ units. This last result is $260 \div 150 = 1.73$ times as great as that obtained per square foot for radiators supplied from the gas engine. It is evident that the average temperature of water heated from a gas engine can be raised but little above that found, if all of the heat in the jacket water is to be utilized. Thus, if the drop of temperature of the circulating water from the gas engine is reduced to 20 degrees, the rise of temperature in the water jacket is $20 \times .62 = 12.4$ degrees, and the temperature of the entering water $150 - 12.4 = 137.6$ degrees. The water, after entering the coils that are heated by the exhaust gases, is now raised in temperature only $20 - 12.4 = 7.6$ degrees, making its maximum temperature $150 + 7.6 = 157.6$ degrees and its average $(137.6 + 157.6) \div 2 = 147.6$ degrees, or only 2.6 degrees higher than when a drop of 40 degrees was permitted. If a larger variation of temperature in the circulating water exists, the average temperature is still lower. A result of the comparatively low temperature of water heated by gas engines is that about 1.73 times as much radiating surface must be used to dissipate heat at a given rate as is the case with the best independent hot-water systems. The cost of additional radiating surface is obviously a small matter compared with the great saving in heat to be made by the utilization of jacket water and exhaust from gas engines. As is well known, higher cylinder temperature, if satisfactory lubrication can be maintained, contributes to an increase of gas-engine efficiency. Such an increase of jacket-water temperature as would permit exhaust gases to raise this water to 210 degrees would therefore add to engine economy and cut down the radiating surface necessary to utilize the waste heat of gas engines. On the assumption that 14,139 heat units are

developed at the gas engine for each brake horse power delivered, it was found that about 5,655 of these heat units pass into the jacket water. Practically all of this heat is available in a hot-water heating system, save the small amount necessary to raise the circulating water to the temperature of the building heated or to the temperature at which the water flows from the heating coils. Of the 5,231 heat units that escape in the exhaust gas, for each delivered horse-power hour, it was found that 66 per cent., or 3,452 heat units, representing 24 per cent. of the total amount developed, can be added to the jacket water after it leaves the cylinder. The total heat available for general purposes from a gas engine, under the stated conditions is therefore about $5{,}655 + 3{,}452 = 9{,}107$ heat units per delivered horse-power hour. It was shown that one square foot of good radiating surface, when supplied with hot water from a gas engine, the drop in temperature at the radiator being 40 degrees, dissipates 150 heat units per hour, in an atmosphere at 70 degrees temperature. For each horse power delivered by a gas engine, about $9{,}107 \div 150 = 60$ square feet of direct radiating surface should be supplied. So many factors enter to determine the heat necessary to warm buildings that no general and exact rule can be given, but allowing 10 heat units per hour for each cubic foot of space warmed, as a rough approximation, $9{,}107 \div 10 = 910$ cubic feet may be heated for each horse power delivered by the engine.

The heat from gas engines may readily be applied to heating purposes in either of three ways—that is, by direct or indirect radiation and by the hot-air system. Pipes and heating surface are proportioned for either of these arrangements with heat from gas engines on the same principles as when a regular hot-water heater is used, except for the lower average temperature of heating surface and perhaps greater fall of temperature for the circulating water. Hot water from gas engines may be used for general heating, not only in private plants and buildings, but also for public supply through mains laid in the street. In this last case, or for any other where the distance or conditions prevent a suitable circulation of the water as a result of its fall in temperature, pumps may readily be used to maintain any rate of circulation desired. Power pumps driven by the gas engines will naturally be employed, and the consumption of gas required to operate them, in a well designed system, will represent only a small fraction of the heat energy recovered from the jacket water and the exhaust gases.

To consider the amount of coal that may be saved by the use of gas-engine exhaust, let the heat developed by the perfect combustion of one pound of coal be taken at 13,000 heat units. The boilers of

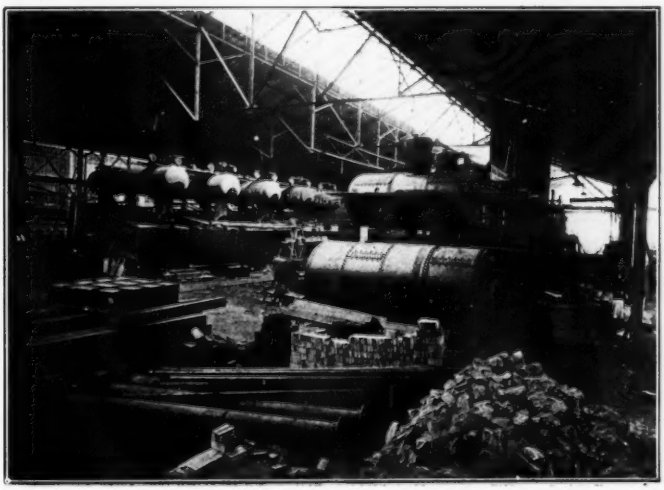
heating systems in buildings may be expected to deliver to steam and hot water hardly more than one-half of the possible heat from coal, or 6,500 heat units per pound of coal burned. As each horse-power hour of operation by the gas engine was found to deliver 9,107 heat units to the circulating water, this amount of operation is equivalent in the heating system to $9{,}107 \div 6{,}500 = 1.4$ pounds of coal burned under the steam or hot-water boiler. In the case of a 100 horse-power gas engine operating the equivalent of 3,000 hours at full load, or 300,000 horse-power hours, the heat imparted by it to circulating water would equal that from $300{,}000 \times 1.4 = 420{,}000$ pounds of coal. This coal, at $4 per short ton, has a value of $840, to say nothing of the labor necessary to operate the boiler and furnace where it is consumed. The arrangement of heating coils to receive the jacket water and add to it the heat of exhaust gases involves only a very moderate expense, and the care of this arrangement could be readily included with that of the gas engine.

So long as the gas-engine cylinder is kept within the desired temperature limits, the operation of the engine is obviously not affected by any use of the jacket water, so only the reaction of the heating system on the exhaust gases need be considered. In order to force the gas-engine exhaust through the bank of heating coils in which the jacket water circulates, a small back pressure must be set up in the engine cylinder. With properly-designed heating coils, this back pressure should be small and thus increase the gas consumption but little. Assuming a mean effective pressure of 50 pounds per square inch on the gas-engine piston, from the gas explosions, and 2 pounds per square inch back pressure, as a result of the heating coils, there would be a loss of 4 horse power on the 100-horse-power engine. In order to bring the engine up to 100 horse power, the gas consumption must be increased by the equivalent of 4(14,139) heat units per hour, by the assumption formerly made, or 81 cubic feet of gas, with 700 heat units per cubic foot. The value of this gas at one dollar per cubic foot is 8.1 cents, but the heat delivered by the gas engine to the hot-water system during one hour amounts to that from $1.4 \times 100 = 140$ pounds of coal under a heating boiler. At $4 per ton the value of this coal is $(140 \times \$4 \div 2{,}000 = 28$ cents, or three and one-half times that of the gas. With gas for gas engines produced on the premises the advantage in favor of the heating system would be greater. There seems little doubt that the large amount of heat now wasted by gas engines will gradually be applied to useful heating operations, as in the case of steam engines.

POWER FEATURES OF THE PARIS EXPOSITION.

By W. H. Donner.

AS an opportunity for the study of engineering, the two power houses of the Paris Exposition rank higher than those of any previous representative show. They are formed by the end sections of the principal buildings on the Champ de Mars, at the southern end, where they are connected by the Palace of Electricity. The engine rooms are each 380 feet long by 100 feet wide. One, situated on the eastern side of the Champ de Mars, is called the Bourdonnais station, and the other, on the western side, is the Suffren station, each taking its name from the neighbouring avenues which line the Champ de Mars. The Bourdonnais station has a further distinction, in that it represents the products of French engineers, while the Suffren station is devoted to foreign boilers and engines. A view of the Suffren boiler room is given below, showing some of the boilers being erected. In the foreground is a group of four, by Berninghaus, of Duisbourg, showing a combination of a Lancashire boiler below and a fire-tube boiler above. On the other side of the central passage are five boilers by Steinmuller, of Gummersbach, quite similar in general

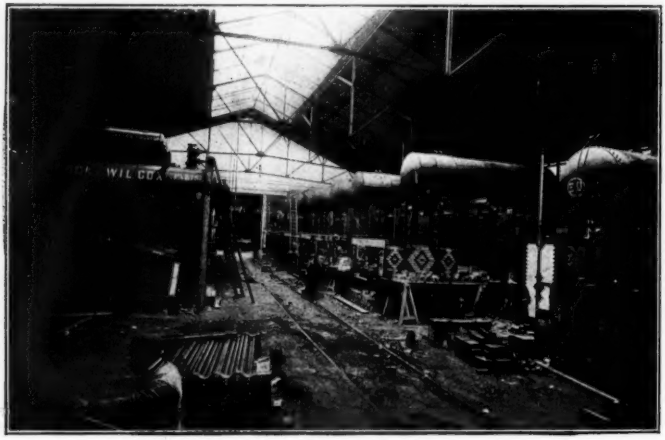


THE SUFFREN BOILER HOUSE AT THE OPENING OF THE EXPOSITION.

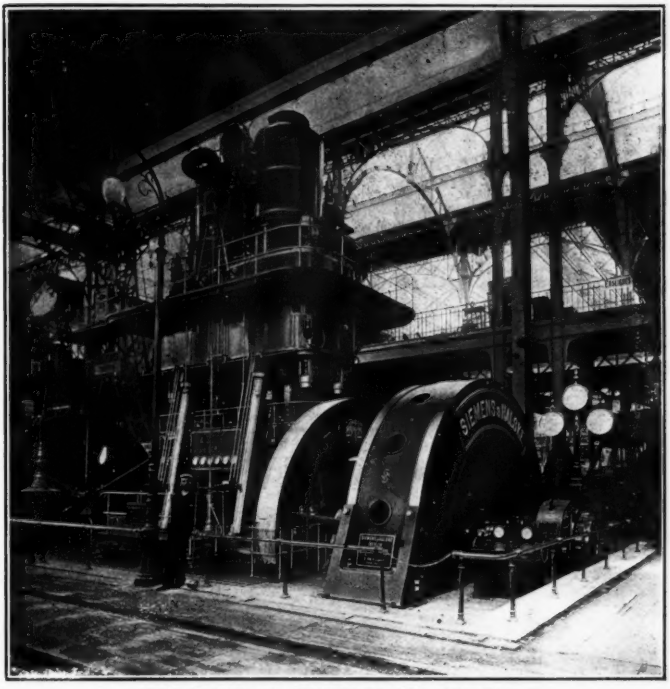
appearance to the Babcock & Wilcox water-tube boilers alongside. This latter company is also represented in the French boiler room, where there is a row of eight boilers of this make. Across from them is a battery of six water-tube boilers by De Naeyer & Co., of Willebroeck, and this station also contains twelve of the same type by J. & A. Niclausse, of Paris. Only four boilers are shown of the composite, or semi-tubular style, and none of the Lancashire type, there being a total of forty-five boilers of the water-tube design, which appears to be more in demand.

The main steam pipes are carried on the iron posts supporting the roof, and run down each side of the building, as may be seen on page 529. Two 10-inch pipes are provided, one above the other, and the steam is brought to two equalising cylinders before passing down into the subterranean passages built for the reception of pipes. One of these cylinders is clearly visible, alongside the square brick shaft which is placed at the end of one of the tunnels, for ventilation, and passes through the roof.

Among the engine builders the Germans have made a very creditable showing, as their large machines, direct-connected to well-known types of electric generators, were ready well in advance of the stipulated time, and would doubtless have been in running order on the opening day had the Exposition been ready with its service of steam and water. Only one, in the German group, is a horizontal engine, and is built by the Augsburg Engine Co. The other three engines



THE BOURDONNAIS BOILER HOUSE IN EARLY MAY.

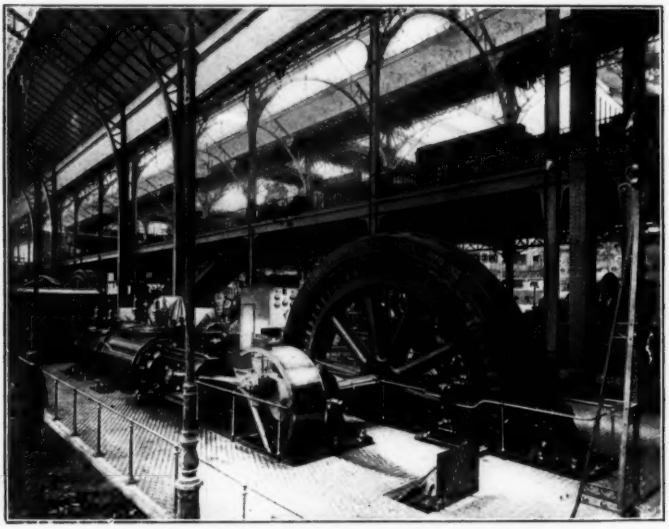


BORSIG ENGINE AND SIEMENS-HALSKE ALTERNATOR.

are vertical, one built by the Nuremberg Engine Co., one by the consolidated Augsburg-Nuremberg Co., and one by Borsig, of Berlin.

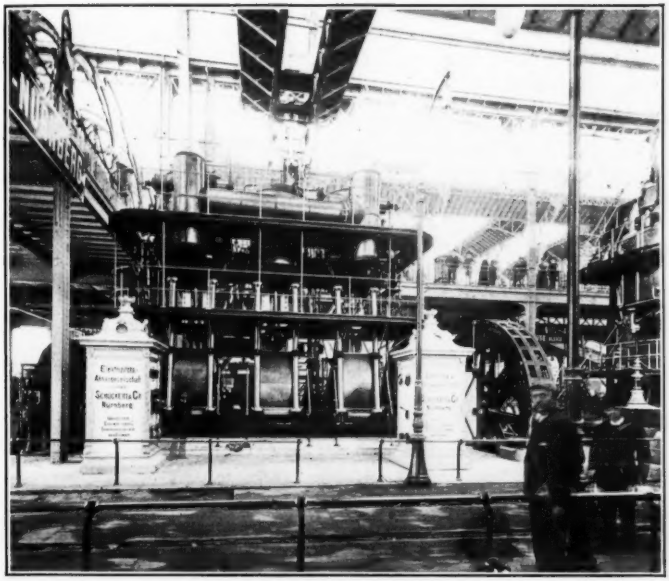
The three vertical engines of the German group are compound, triple-expansion three-cylinder, and triple-expansion four-cylinder, and of 1,500, 2,000, and 2,500 horse power respectively. The cut shows the largest of these, by Borsig, of Berlin, direct coupled to a three-phase 2,200-volt generator by Siemens & Halske. The sizes of the cylinders are 30 inches, 46½ inches, and 52¾ inches, with a stroke of 47¼ inches. In order to balance well in running, the cranks are placed at an angle of 180°. Beyond the Borsig engine is the three-cylinder engine by the consolidated Augsburg & Nuremberg Engine Co., giving an output of 2,000 horse power at 83 revolutions per minute, the same speed as the Borsig engine. The cylinders are approximately of the same dimensions, 30½ inches, 48¾ inches, and 71 inches, but the stroke is less by about 4 inches.

The Augsburg company make a specialty of horizontal engines, while the Nuremberg company build more of the vertical type. The horizontal engine, shown opposite, is triple-expansion, with four cylinders, and of 1,900 horse power with steam at the station pressure of 140 pounds per square inch. The shaft carries at its centre the revolving field of a 1,060-kilowatt Helios alternator, running at 70 revolutions per minute, and furnishing three-phase or single-phase current. The bearings of the shaft are 15 feet 6 inches between centres, and in diameter about 20 inches. One of the noteworthy features of this engine is the system adopted of arranging all the control in such a way that the regulating mechanism for both mechanical and electrical operation is readily accessible from one central point.

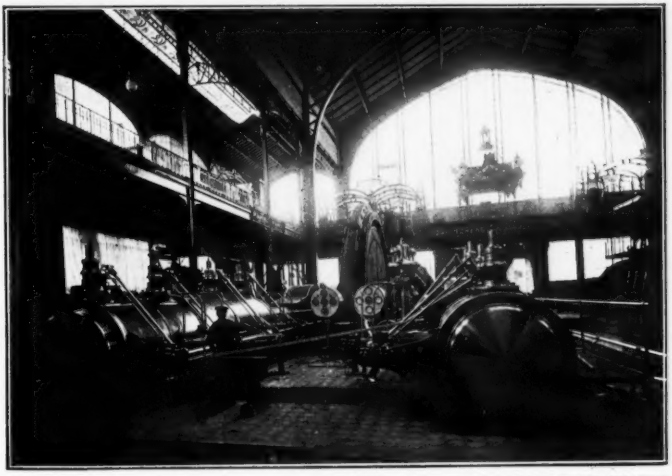


1,000 HORSE-POWER ENGINE, BY CARELS BROS., OF GHENT.

In the Belgian section we find a horizontal tandem-compound engine of 1,000 horse power, by Carels Bros., of Ghent, the cylinders being 26 inches and 41⅓ inches, and the stroke 45¼ inches. The valves rise vertically from the seat to admit steam, as is the case with several engines in the foreign station, and they are worked in this case by cams on a long transmission shaft driven by bevel gearing from the main shaft. The exhaust passes into a jet condenser under the floor level. We might make some comparisons between this engine,

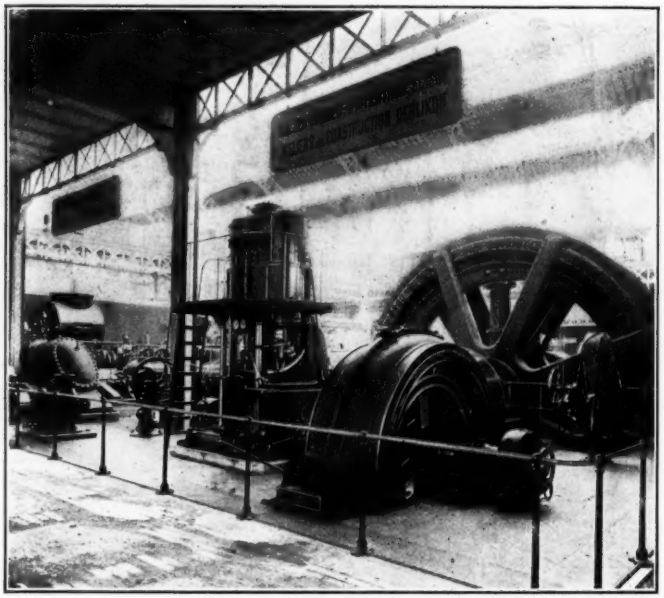


2,000 HORSE-POWER ENGINE BY THE NUREMBERG ENGINE CO., WITH DYNAMOS BY SHUCKERT & CO.



AUGSBURG ENGINE COMPANY'S 1,700 HORSE-POWER ENGINE AND HELIOS ALTERNATOR.

which is tandem-compound, and the single-cylinder Weyher & Richemond, both being of the same output. The stroke of the two engines is 45¼ inches and 39⅜ inches. Although the power is in both cases brought to bear on a single crank, the framing of the Belgian engine is lighter. The valves also are easier to inspect, as they are well sepa-



SULZER 400 HORSE-POWER HIGH-SPEED ENGINE.

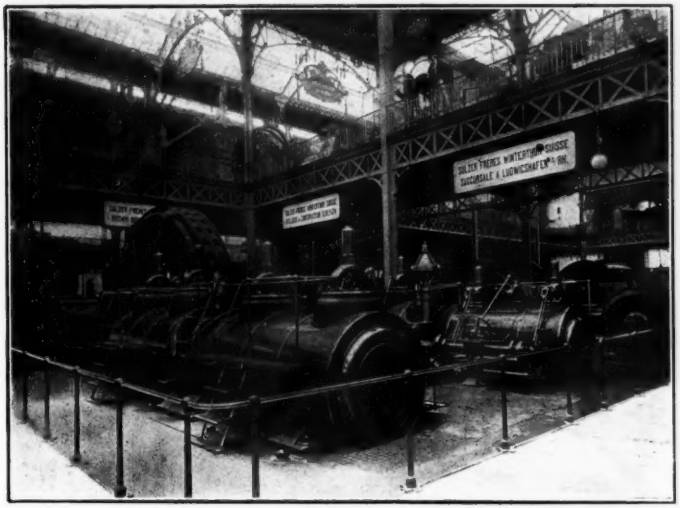
rated and readily accessible, and the cylinder heads are left free. The valve motion of the Carels low-pressure cylinder is similar to that used in a new engine by Sulzer Bros., of Winterthur, Switzerland, who employ a rocking lever to raise a disc valve, giving a sudden quick movement immediately after the valve has begun to open.

Of the above engines the Augsburg & Nuremberg Co.'s machine shows the lowest piston speed, 598 feet per minute, and the Augsburg Engine Co. use a speed of 735 feet per minute. Borsig and Carels come between, with 654 feet and 709 feet per minute, respectively.

Sulzer Bros. have what is probably the finest exhibit of any one manufacturer. Only one of their machines is required for administrative lighting, but they have two large engines driving alternators, in addition to the small engine placed at the disposal of the Exposition.

One of these engines, of 1,500 horse power, has four cylinders and makes use of triple expansion, the low-pressure cylinders being at the crank end. This construction was adopted in order to keep the cross-head cooler than was the case when the high-pressure cylinder was towards the crank, as in a previous design. This engine runs with great smoothness, and would doubtless give a good account of itself were it tested under load. The general effect of this installation is shown in the illustration below.

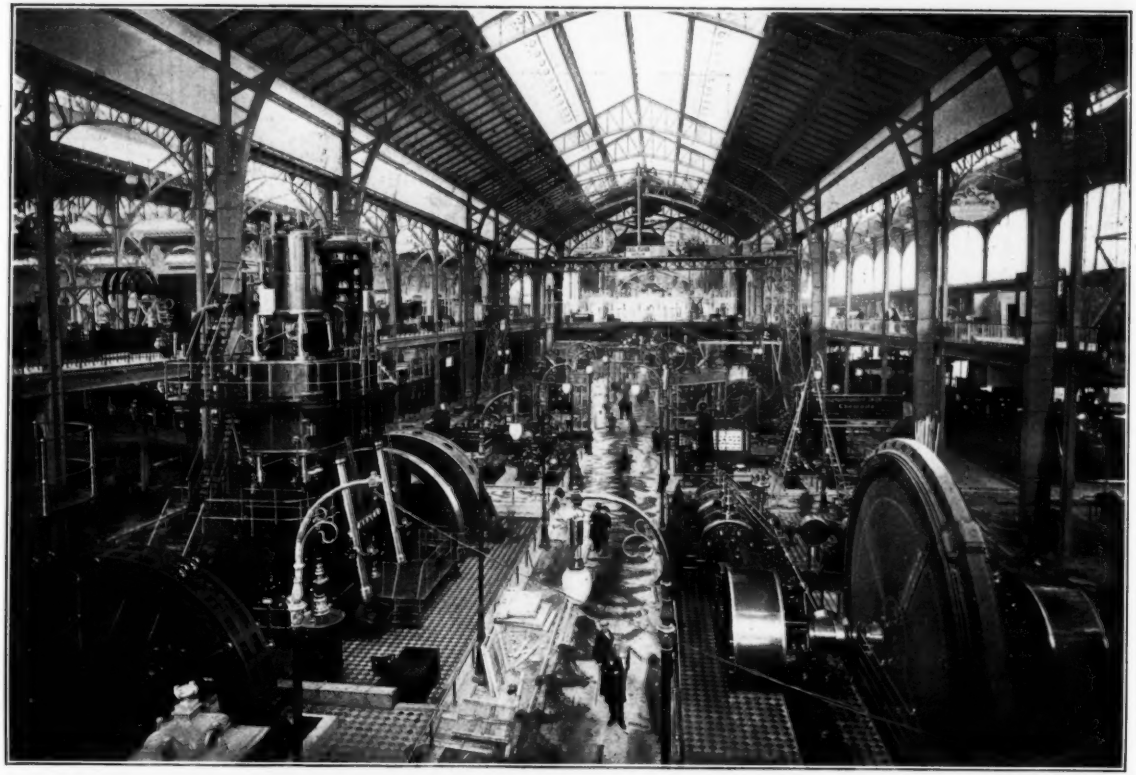
One of the neatest generating units in the Exposition is the vertical double compound 400 horse-power engine by Sulzer Bros., driving an alternator by the Oerlikon Co., and used for illuminations round the outer façade of the Champ de Mars buildings. The engine is of twin design, having two high-pressure and two low-pressure cylinders, and cranks at 180°. The valves of the corresponding cylinders are



1,500 HORSE-POWER ENGINE BY SULZER BROS., OF WINTERTHUR.

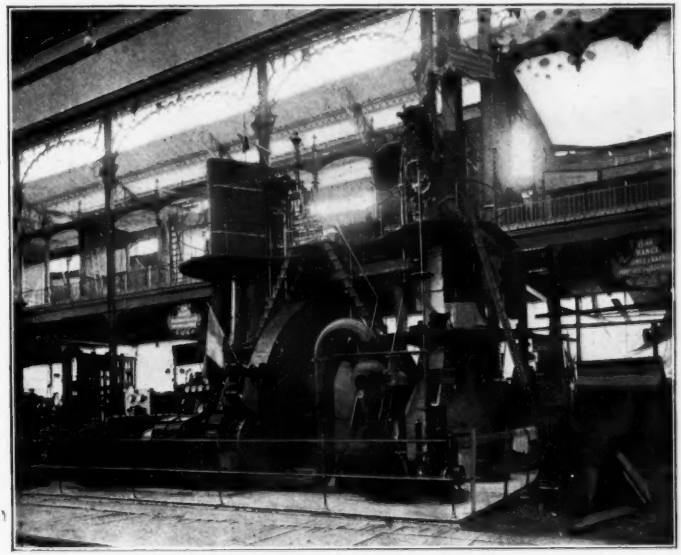
connected by rods which communicate identical motion to each set. The form of the valves is cylindrical, and steam admission and exhaust are obtained by a rotary movement.

The center of the foreign engine room is occupied by an exhibit of machine tools, as will be seen in the general view taken from one of the galleries. At the further end are visible the towering cylinders of the Willans 2,400 horse-power central-valve engine, in the section set apart for the British manufacturers. It is here that the work of instal-



GENERAL VIEW OF THE FOREIGN POWER HOUSE FROM THE GALLERY

lation showed the most delay, as there were in some cases but foundations to be seen for some time after the day of inauguration of the Exposition. The transportation system was at fault throughout, especially with regard to machinery coming from over the sea. One of the finished exhibits at present is that of C. A. Parsons & Co., who have two steam turbines driving dynamos for lighting. Only one of these machines is connected to the steam mains; it is built over the condenser, which furnishes a rigid sub-base and concentrates the whole into a very small compass. In the French engine room there are two Laval turbines of 300 horse power each, furnishing current

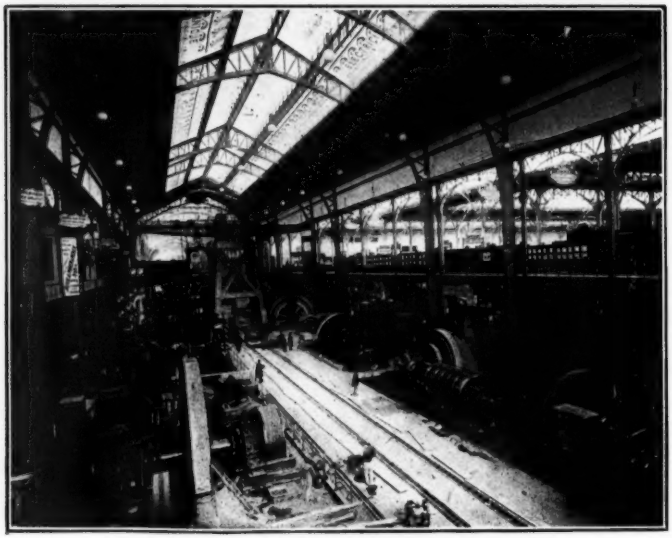


E. P. ALLIS ENGINE AND DE LAVAL STEAM TURBINE.

for lighting from their twin dynamos. The Parsons turbine is not required to supply current, as the number of machines on hand to draw from is greater than necessary, notwithstanding the brilliant illuminations to be provided later on. Close to one of the Laval turbines is what may be called an American exhibit—a vertical compound Reynolds-Corliss engine built by a French company (Anciens Etablissements Cail) from designs by E. P. Allis, of Milwaukee, and a three-phase 5,500-volt alternator by the Postel-Vinay Co. for the French Thomson-Houston Co. The United States are not represented further than this as engine builders; but it is to be remembered that most

American manufacturers pay less attention to export trade than do other nations, who have not such an extensive home demand, and rights of construction for foreign countries are often sold outright.

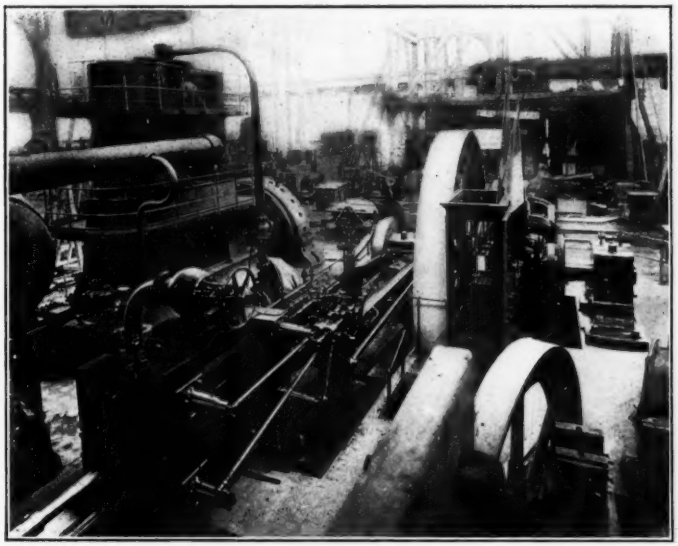
Among the French engines of the Bourdonnais station there is much variety, and wide distinctions are made in design. One engine, which comes in for special comment and criticism, is of 1,000 horse power, all in one cylinder, and drives a direct-current 14-pole dynamo for incandescent lighting. Anticipating the objection which would naturally be made with regard to fluctuation in speed, a specially heavy flywheel is provided. This may serve the purpose very well, and the single cylinder certainly seems to find favour with the French, for there are five machines of that type in their section, although the foreign builders all use compound cylinders or triple expansion. Triple expansion, on the French side, is limited to two machines, one of which, a vertical enclosed engine of 1,250 horse power, by Delaunay-Belleville & Co., is shown on the left in Fig. 5. Four cylinders are used, the high-pressure and intermediate being above, and the



THE FRENCH POWER HOUSE, SEEN FROM THE GALLERY.

two low-pressure cylinders below. The diameters of the cylinders are: high pressure, 19⅝ inches; intermediate, 24¾ inches; low pressure, each 33½ inches. The stroke is 50 centimetres, equal to the diameter of the high-pressure cylinder, giving a piston speed of 820

feet per minute at a rotative speed of 250 revolutions per minute. The generator on the extension of the shaft is a three-phase machine by Breguet, giving 700 kilowatts at 2,200 volts. The exciter is quite independent, and is driven by a de Laval steam turbine.



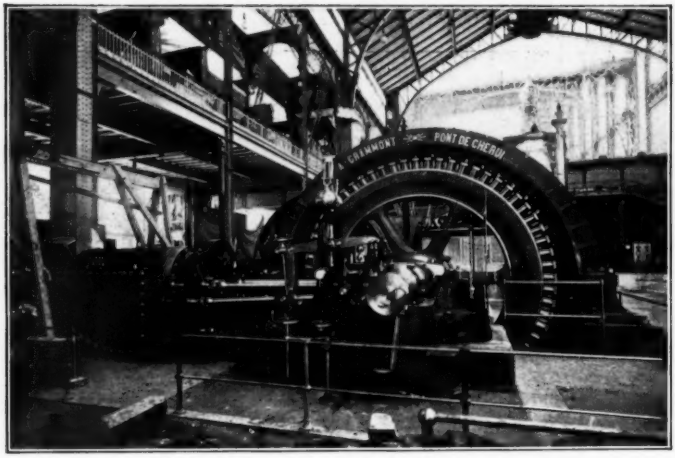
HORIZONTAL ENGINE BY E. GARNIER & FAURE BEAULIEU, AND VERTICAL ENGINE BY THE DELAUNAY-BELLEVILLE CO.

The horizontal engine above is by Garnier & Faure-Beaulieu, single-cylinder, condensing, 400 horse power, running at 90 revolutions per minute. The air pump is placed end on to the cylinder, instead of being driven from the crank pin as in the case of the foreign engines. The steam valves are of the Corliss type; in the triple-expansion engine above mentioned piston valves are used; and there is one example of a large engine of 600 horse power, by Piguet & Co., in which a flat slide-valve is used.

The greater number of the engines use the steam at the pressure of the mains, 140 pounds per square inch, but some of the German marine type engines were designed for 200-pound steam in regular use. The single-cylinder engines do not require even 140 pounds pressure, and four out of the five use reducing valves.

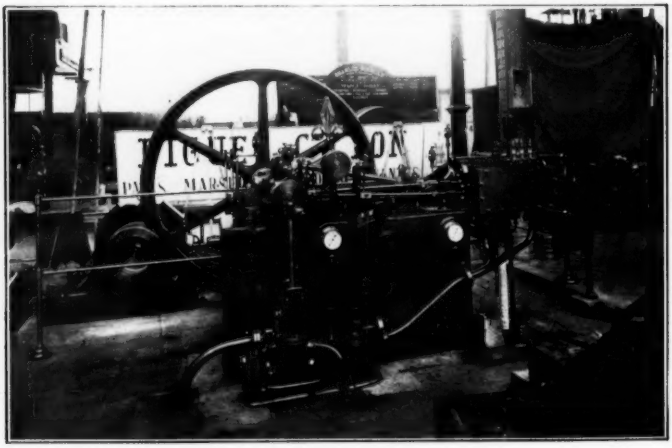
An interesting engine, but curious in some respects, is shown by Piguet & Co. in the French power house. This is a single cylinder 600 horse-power engine running at 94 revolutions per minute, and having

a slide valve and cut-off valve such as one would expect to see only on engines of small power. The construction throughout seems heavy

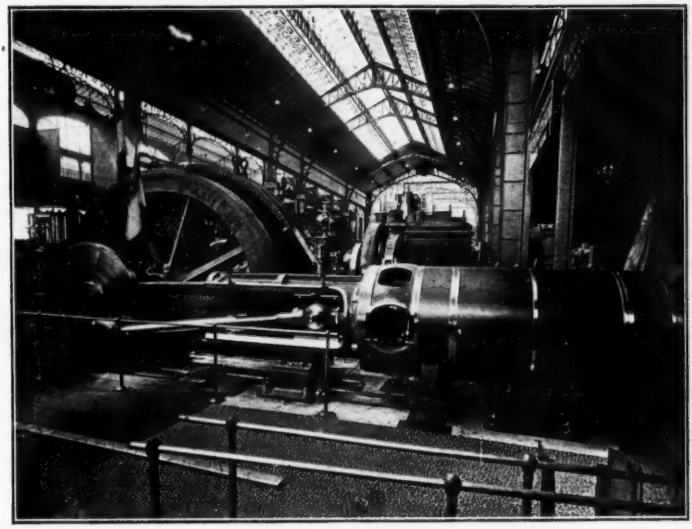


600 HORSE-POWER ENGINE BY PIGUET & CO.

and the governor rather awkward, but the finish is excellent and the running smooth. The crosshead has no upper guide, so that the engine cannot run under. Close to this exhibit is a very small engine by the same maker, of only 25 horse power, having all the characteristics

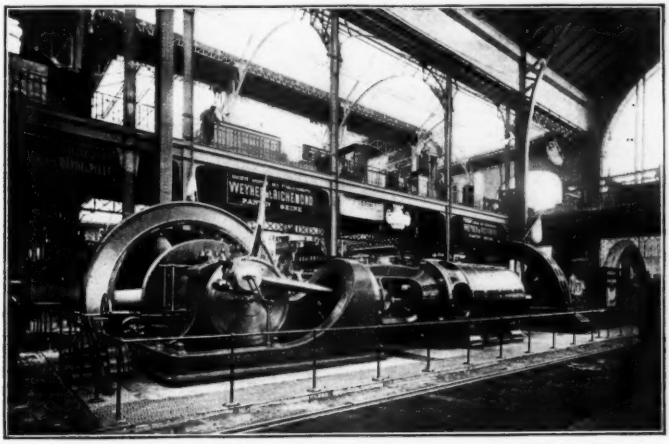


25 HORSE-POWER ENGINE BY PIGUET & CO.

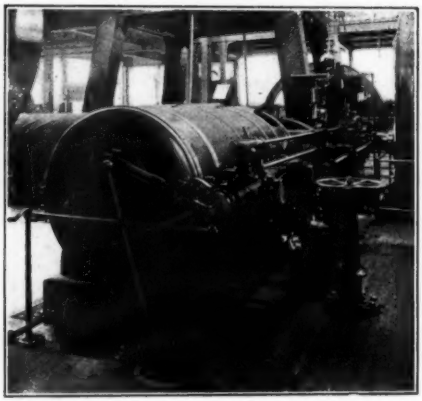


500 HORSE-POWER ENGINE BY WEYHER & RICHEMOND.

of the larger machine, which really appear more suitable when reduced to this size. Mounted on a raised platform, and provided with every appliance used on the 600 horse-power engine, it forms a pretty model. A small dynamo is driven from the flywheel by frictional contact.



WEYHER & RICHEMOND 1,000 HORSE-POWER SINGLE-CYLINDER ENGINE.



VALVE GEAR OF THE WEYHER & RICHEMOND 500 HORSE-POWER ENGINE.

The exhibit of Weyher & Richemond comprises three engines, two of 1,000 horse power and one of 500 horse power. One of the larger size, heavily built, has an exceptionally short stroke, and all of the power is obtained by the use of a single cylinder. This seems a daring extension of the design of the 500 horse-power engine which is set up at right angles to it in the space allotted to this company. The bedplate of the larger machine is considerably strengthened, as compared with the smaller, in order to secure sufficient rigidity. Some of the builders of triple-expansion engines in the foreign section hardly regard with favour such a decided variance from their own ideas of design; but there are advantages in a single-cylinder engine, such as simplicity of parts and ease of repair, even though the efficiency may not be quite so high. The cylinder diameter appears greater than it actually is, on account of the steam jacket, and, on the other hand, the length of the cylinder is less than the outside measurement by the space taken up at each end by the valve chests. The valves are operated from the main shaft by bevel gears and rods, instead of by eccentrics, and have a twisting motion on the cylinder heads, covering the steam ports with corresponding arms. From a practical standpoint these valves seem undesirable on account of difficulty of access, and some of the wearing parts of the mechanism are light. Both these engines will be running regularly as soon as the electric illuminations are in order, and a time test may show good qualities perhaps lacking in a more usual design.

THE HISTORY AND PROGRESS OF MINING IN BRITISH COLUMBIA.

By H. Mortimer Lamb.

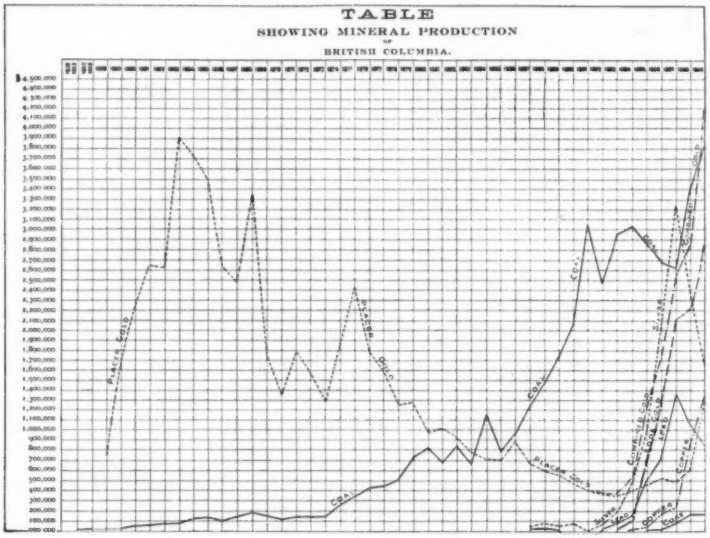
THE first authenticated discovery of gold in British Columbia, according to Dr. G. M. Dawson, occurred at Mitchell or Gold Harbour, on the West Coast of Queen Charlotte Island, in 1851, a nugget weighing several ounces having been accidentally picked up by an Indian woman on the seashore. This nugget was brought to Fort Simpson, and coming into the possession of the officer in charge of the Hudson Bay Company's post at that place, was forwarded by him to the company's headquarters at Victoria. An expedition was at once fitted out and, proceeding to the spot, succeeded in locating a quartz vein 7 inches wide, "reported to contain 25 per cent. gold in some places."* The find was worked for some months and then abandoned, the narrow vein entirely giving out; no other indications of mineral were ever found on the island, notwithstanding that this extraordinary little seam of quartz had yielded, in the few weeks it was worked, a value of $20,000 on the word of one authority, or $75,000 on that of another. About the same time coal, which had been discovered on Vancouver Island as far back as 1835, began to be mined in earnest at Nanaimo.

But the Fraser River excitement of 1858 may be fairly described as the genesis of the mining industry in British Columbia. In the April of that year the first shipload† of 540 miners left San Francisco for the new El Dorado, and by the following June, it is estimated, over 14,000 persons had embarked from that port. But while this was the inauguration of gold mining in British Columbia, the actual returns of $543,000 for the season of 1858, from June to October inclusive, were considered disappointing, and so great were the natural difficulties of the country —unprovided, too, as it was then with means to support a large population—that a greater number of the immigrants returned to California

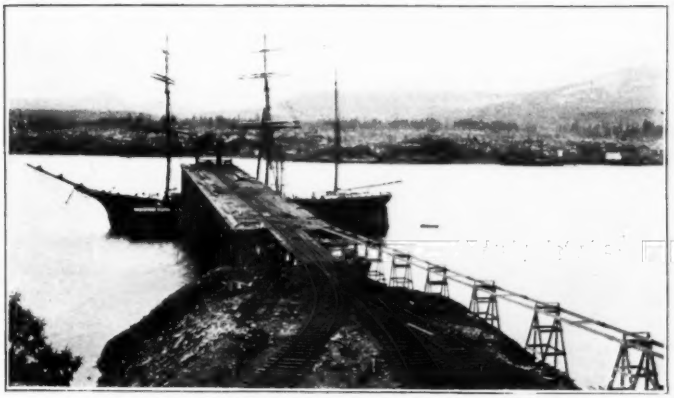
* Mineral Wealth of British Columbia; Geol. Survey Canada, 1888.

† Bancroft's History of British Columbia.

early in the following year. In 1859-60 good diggings were discovered at Fountain, above Lilloett, on the Fraser River, on the Thompson River, the Similkameen River in the southern portion of the Province, at the forks of the Quesnelle River and at Antler Creek in the Cariboo district. But it was not until 1861 that the two most noteworthy discoveries of Williams and Lightning Creeks in the Cariboo district occurred and created a second considerable migration of miners to western Canada, which increased in volume until 1864. The average value of gold obtained per lineal foot of channel of certain claims on Williams Creek is given in the report of the provincial minister of mines



for 1875 as $1,075. The production of Lightning Creek, while less in the aggregate than Williams, was greater while it lasted, and from this creek alone gold to the value of $2,179,272 was extracted. As will be seen from the accompanying chart, the maximum production of placer gold was reached in 1863, when the output, almost entirely from the Cariboo district and from Wild Horse Creek in South East Kootenay, was $3,913,563, and the average annual earnings per man, $889. Until 1867 the production gradually but steadily decreased, although previout to that year fresh discoveries of alluvial gold were made at Leech River, on Vancouver Island, and at the bend of the Columbia River, in north Kootenay. The increased production in 1868-69 and in 1874-75-

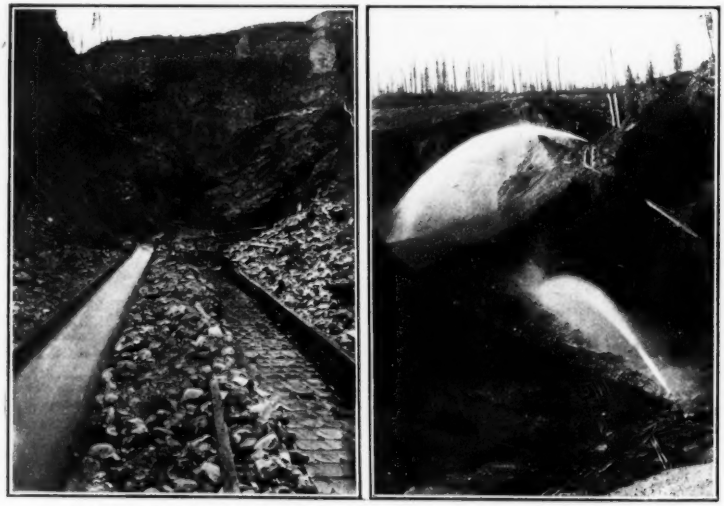


COAL SHIPMENT WHARF AT PROTECTION ISLAND, NANAIMO, B. C.

76 is doubtless due to respectively the discoveries in the Omineca district, near latitude 56, and in Cassiar, still farther north. From this latter district gold to the value of $1,000,000 was taken out in 1874, this being more than 50 per cent. of the total production of the country for that year. In 1888 the value of the production of placer gold had fallen to not much above half a million dollars. Whereas in 1875 the number of miners employed was 2,024 and the annual average earnings per man $1,222, in 1888 the average individual earning was but

NO. 1 SHAFT, NEW VANCOUVER COAL CO., NANAIMO, B. C.

$307 for 2,007 men employed. The early miners worked the bars, the outcrops of the coarser wash in the terraces, and the creek and bench deposits, with no other appliances than picks and shovels, rockers and sluices. In the deeper ground in the Cariboo district sinking and drifting was resorted to, but here, too, only apparatus of the crudest, hand-manufactured type was in use. Early in the 70's, hydraulicking was attempted with cotton hose and with perhaps a 2-inch nozzle and rarely more than a hundred feet of pressure. Within the last six or seven years, however, the old—and, so far as the individual miner is concerned, worked-out—diggings of Cariboo, Omenica and Cassiar have become re-vitalised. In these districts some very important enterprises, involving large capital expenditures, are being conducted under the supervision of highly trained and skilled engineers. As yet in no instance has the success in these several undertakings been quite reached, although several are within a measurable distance of that consummation. Some of the Cariboo hydraulic schemes, in particular, by their magnitude are worthy of special mention. One of these was an



A CANAL AND SLUICE, AND HYDRAULIC MINING IN THE CARIBOO DISTRICT.

undertaking which was carried out at a cost of $250,000, to dam back the waters of the Quesnelle Lake at its foot, and where the South Fork of the Quesnelle River, as it leaves, is a little more than 400 feet wide. In the past a great quantity of gold had been won from the bars and bottom of this river; but it was thought that owing to the rapid flow of

the stream (which runs 12,000 cubic feet per second in low water and 24,000 cubic feet in high water, in a succession of rapids between canyon-like gorges), the gold could not have been recovered from the main channel with the primitive methods employed at the earlier period, and consequently that by erecting a barrier at the outlet of the

THE DAM AT THE OUTLET OF QUESNELLE LAKE.

lake this channel could be laid bare and the gold recovered during the season of low water in the early spring and autumn months. The conception was sufficiently bold and even plausible, but since the dam was completed the result of preliminary work in gold getting has hardly as yet justified the high expectations of the originators of the project.

Another big enterprise, comparing favourably with any of a like nature in the world, comprises the mining by hydraulic process of a property in the same neighbourhood, aggregating 2,554 acres, and covering for a distance of about ten miles the auriferous deposits of a system of ancient rivers. These deposits vary from 400 to 600 feet in depth from surface to bottom of channel, and it is estimated contain 500,000,000 cubic yards of high-grade auriferous gravel available for future washing, the average gold tenure being modestly computed at 20 cents per cubic yard, and the total gold content at $100,000,000. The equipment at this mine consists of a portable hydraulic plant of four lines of 30-inch and 22-inch riveted steel pipes, aggregating 6,000 feet; six No. 8 hydraulic giants with deflecting nozzles, varying from 6 to 10 inches in diameter; and the gold-saving appliances include a double extended system of sluices, 7 feet wide by 4 feet deep, aggregating 2,380 feet in

length. The sluices are paved partially with end-wood sluice blocks 1 foot thick, and partially with improved longitudinal steel riffles, while the installation is about to be made of two improved undercurrents intended for the recovery of flour quicksilver, fine gold, platinum, and osmiridium that cannot be saved in the ordinary sluice. A few figures relative to the operation of this property during the last three years may prove interesting:

Gravel Washed, Cubic Yards.	Duty per Miner's Inch, Cubic Yards.	Value per Cubic Yard (Cents.)
1897.		
413,058, mostly top gravel,	$3.84	$17.20
345,231, " " "	3.44	16.10
*81,817, " " "	5.12	6.90
1898.		
350,000, " " "	2.44	21.00
35,070, bottom gravel,	1.10	67.15

Operating Expenses.	Cents per Cubic Yard.
Labour	$3.80
Explosives	2.40
Maintenance of Plant	2.58
Management and Office Expenses	1.05
Sundries	1.77
	$11.60

Gravel Washed, Cubic Yards.	Average Value (Cents).	Cost (Cents).
1899.		
1,052,535, gravel, boulders, etc.,	$27.$\frac{3}{10}$	$5.54

* Mostly boulder clay.

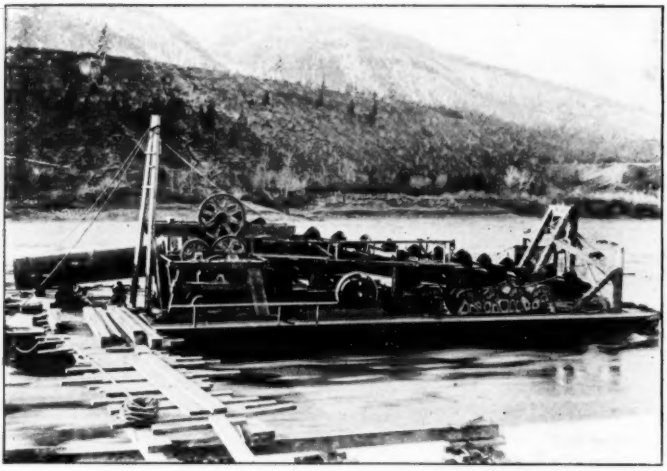
It is only fair to add that these costs of operation will be still further reduced in the near future.

On another property an interesting mining problem under entirely different conditions has been developed in a gravel deposit five miles south of Quesnelle Lake. Here the bed of the channel has been found to dip at a very flat angle, and the entire gravel bank has become a hard cemented mass. An attempt was first made to work this out with monitors, but as the face advanced the gravel began to get harder, and as the amount of cement was increased the wall was broken down with enormous charges of powder; but hydraulicking was found to be unavailing in disintegrating the masses thus shattered, which were swept with most of the contained gold out to the dump. Milling tests of a favourable nature having been made in San Francisco, giving gold returns of $4.85 and up to $5.56, a tentative plant was erected consisting of two self-feeders, two batteries of five stamps of 850 lbs., drop 7 inches, 90 to 100 per minute. From the mill returns it has been shown

that with the ten-stamp battery 135 tons of cemented gravel can be crushed per twenty-four hours. The total cost of mining and milling has not exceeded $1.40 per ton.

Although the opportunities for the remunerative investment of capital in alluvial mining in this district are good, some time must elapse before the field is thoroughly exploited, and while there is abundant evidence of quartz leads, values are too low to permit of profitable mining under existing conditions of labour and transport. In the early 60's the cost of transportation of supplies from the sea-board to the mines was a dollar per pound. The present rate is from six to seven cents, and thus the freight charges on mining machinery and supplies are still not infrequently greater than the first cost of the articles themselves.

Some attempts have been made to dredge the bottoms and bars in the upper Fraser and Quesnelle rivers; but as these undertakings were often begun without due inquiry or investigation, and again because they were conducted by men lacking in experience, and the suction-



A DREDGE ON THE FRASER RIVER, IN COURSE OF CONSTRUCTION.

pump type of dredge generally used was unsuitable, very limited success has attended effort in this direction in the past. It remains to be seen whether better results will attend the use of dredges built after the New Zealand pattern, which have lately been introduced; but in the majority of the rivers and streams the velocity of the currents and the size of the boulders in the channels present serious difficulties.

The revival of placer gold mining in British Columbia, of which

VAN WINKLE BAR GOLD MINE, FRASER RIVER, NEAR LYTTON, B. C.

THE DISCOVERY CLAIM, PINE CREEK, ATLIN DISTRICT.

the evidence is the gradually increasing production, while ascribable in part to the adoption of modern gold-mining methods, is also due to the recent discovery in the extreme northern limits of the province, and east of the Pacific Coast mountain ranges, of alluvial gold deposits of very fair promise. From this district last year royalty was paid on 26,579.52 ounces of gold. The discovery of this field is quite recent and consequently only primitive processes of gold-mining have been as yet

MINING ON PINE CREEK IN THE ATLIN DISTRICT.

applied, but to deal with the conditions economically hydraulic methods—including in places the use of elevators—will have to be resorted to, when the best results may be anticipated. But placer mining, as compared with lode mining, takes, in the consideration of the British Columbia industry, quite a secondary place in point of importance, although the latter is of relatively recent origin and growth.

CHAIN PUMPS AT WORK ON PINE CREEK, IN THE ATLIN DISTRICT.

Seventy years ago the Hudson Bay Company discovered and worked a galena vein in the Ainsworth district of West Kootenay, converting the ore into bullets for trade with the Indians; but productive mining in the Kootenays and other quartz districts can not be said to have actually commenced prior to 1887. About that year prospectors, of which the neighbouring States to the south had bred a sturdy class, began, in spite of the incredible physical difficulties of an unexplored, mountainous, and heavily timbered country, to turn their attention to the territory adjacent to Kootenay Lake and the Columbia River, to East Kootenay and the interior plateau; but with the exception of the Hall group of mines near Nelson, no notable discoveries were made until the summer of 1890. In July of that year all the more important mines of the Rossland camp were located, including the Le Roi, War Eagle, and Centre Star, and the autumn of the following year witnessed the discovery of the extraordinarily rich silver-lead mines of the Slocan region. From this time onward prospecting was vigorously prosecuted throughout the southern and central portions of the province, the whole of which has been found to be more or less richly min-

eralised. In view of the fact that the first discoveries occurred but seven or eight years ago, it is hardly necessary to state that lode mining in British Columbia is yet in its infancy. Nevertheless the development and progress made in this short period of time is very strikingly evidenced in the following table* of production of lode mines:

YEAR	GOLD.		SILVER.		LEAD.		COPPER.		TOTAL VALUES.
	Oz.	Value	Oz.	Value.	Pounds.	Value	Pounds.	Value.	
1887	.....	.....	17,090	$17,331	204,800	$3,216	.....	.....	$26,547
1888	.....	.....	79,780	75,000	674,500	29,813	.....	.....	104,813
1889	.....	.....	53,192	47,873	165,100	6,498	.....	.....	54,371
1890	.....	.....	70,427	73,948	*Nil.*	*Nil.*	.....	.....	73,948
1891	.....	.....	4,500	4,000	*Nil.*	*Nil.*	.....	.....	4,000
1892	.....	.....	77,160	66,935	808,420	33,064	.....	.....	99,999
1893	1,170	$23,404	227,000	195,000	2,135,023	78,996	.....	.....	297,400
1894	6,252	125,014	746,379	470,219	5,662,523	169,875	324,680	$16,234	781,342
1895	39,264	785,271	1,496,522	977,229	16,472,464	532,255	952,840	47,642	2,342,397
1896	62 259	1 244,180	3,135,343	2,100,689	24 199,977	721,384	3 818,556	190,926	4,257,179
1897	106,141	2 122,820	5,472,971	3,272,836	38,841,135	1,390,517	5 325,180	266,258	7,052,431
1898	110,061	2 201,217	4,292,401	2,375 841	31 693.559	1,077,581	7,271,678	874,781	6,529,420
1899	138,315	2,857,573	2 939,413	1.663,708	21,862,436	878,870	7,722.591	1,351 453	6,751,604
	463,462	$9.359,479	18,612.778	$11.340,609	142,722,937	$4,928.069	25.415,525	$2,747.294	$28,375.451

As will be noticed, silver and lead were the first minerals produced, and the circumstances may be largely explained on the ground of the exceptional richness of the galena ores of the country, and more especially of those of the Slocan district. Thanks to these high-grade qualities the original discoverers in many instances succeeded in working the properties with profit from the "grass-roots" without the assistance of capital. Thus, before railways were constructed through

KOOTENAY LAKE, BRITISH COLUMBIA.

this district, a relatively large quantity of ore was mined and "packed" out on horseback a distance of 17 miles through thick forest to a point on Kootenay Lake, at a cost of from $40 to $45 per ton. It was then forwarded by boat and rail to smelters in the United States at a further cost of $20 a ton. Add to this the cost of mining and treatment,

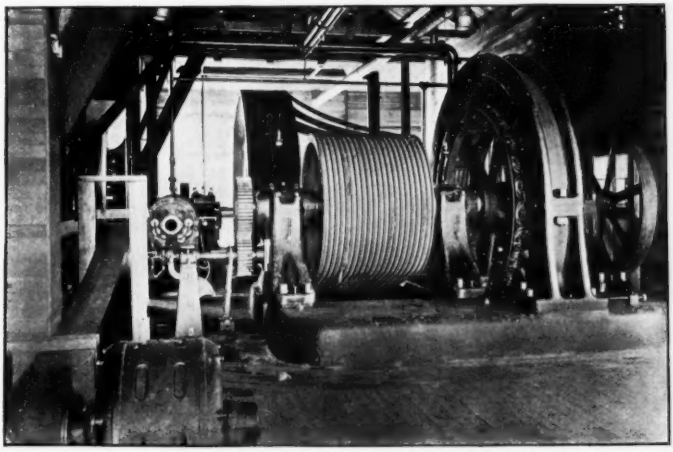
* From advance sheets Minister of Mines' Report, 1900.

and it will be readily admitted that only remarkably high-grade ore could stand so heavy a tax and yet admit of profitable extraction. From facts at my disposal, I do not hesitate to assert that the average metallic percentages of some of the Slocan argentiferous ores cannot be bettered in any other part of the world.

With the completion in 1894-95 of railways, the construction of which was not unattended with engineering difficulties, having regard to the high altitudes and the mountainous character of the country generally—an era of active mining development on a much more extensive scale was inaugurated, each year thereafter, until 1898, showing an increase of output of considerably more than 100 per cent. The

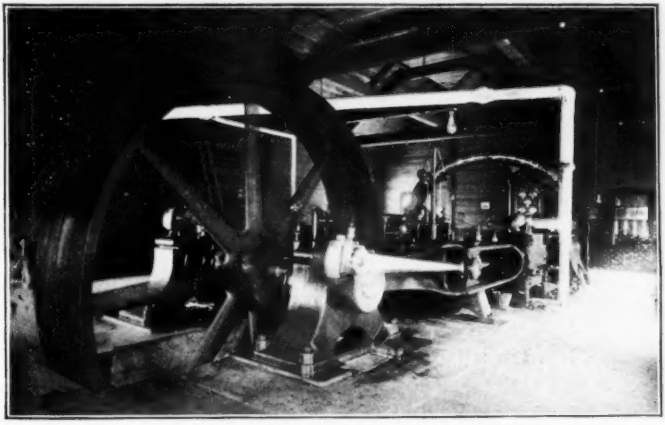
FACE OF TUNNEL, CLIFF MINE, ROSSLAND, B. C.
About 300 feet in.

maximum production was reached in 1897. The unusually low price of silver towards the close of that year and in the spring of 1898, together with the uncertainty as to the future price of the metal, and furthermore the increase of the duty on lead imported into the United States—our principal market—acted as a serious check to the young industry; and when, towards the close of the year, the price of silver again advanced, it had become too late for the resumption of shipments. Meanwhile at many of the larger producers advantage was taken of the opportunity to extend development operations and to block out ore-bodies. Hence the outlook for an exceptionally large production last year was peculiarly bright. These prospects would



AIR COMPRESSOR AT WAR EAGLE MINE, ROSSLAND.

certainly have been realised but for the unfortunate passage of an act by the provincial legislature limiting the day's work underground in metalliferous mines to 8 hours, under a penalty. While this legislation may not have been the direct cause of the friction which subsequently ensued between masters and men, it certainly precipitated matters, the result of which was the closing down of the majority of the Slocan mines from June to December. Previous to the passage of this act the miners in this district were paid $3.50 for a working day

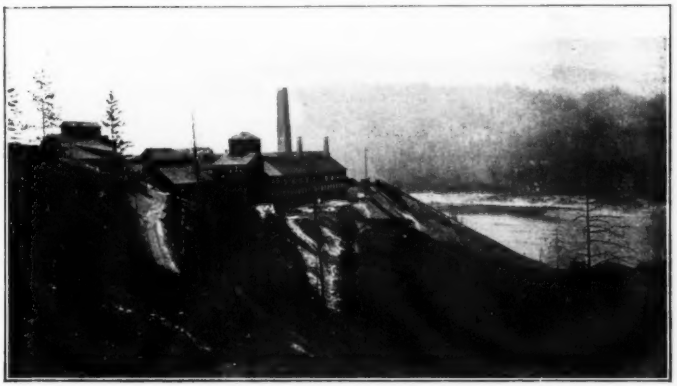


BLACK BEAR AIR COMPRESSOR, ROSSLAND CAMP.

of nominally 10 hours. The actual time, however, spent in the breast was rarely more than 9 hours. When the "8-hour law" came into force the miners, through their local unions, refused to accept a corresponding reduction of wage, giving as reasons for their refusal the contentions that (1) the average miner would do as much work in 8 hours as in 10; and (2)—which would seem to be a still less rational argument—"that the Slocan mines are so rich that the owners can afford to pay higher wages." Both sides remaining obdurate, the mines were closed until quite recently, when a compromise was at length effected, the owners offering and the men accepting a wage of $3.25 for a working day of 8 hours.

It should be stated that there is no economic problem in Western Canada to-day representing greater difficulties of solution than that involved in the question of the general inefficiency and unproductiveness of labour in this country in relation to its cost. The mean standard of efficiency of miners in British Columbia is markedly lower than in any other mining territory in North America; yet the scale of wage is as high as, if not higher than, that in force in most parts of the United States. But it is upon that country that British Columbia is chiefly dependent for skilled mine labour, and as the inducements offered are not sufficiently great to induce to any considerable extent immigration of men who at home are certain of employment at a highly remunerative rate of wage, skilled American miners are in the minority and a large portion of the labour employed in the British Columbia mines is, therefore, made up of a heterogenous class com-

CONCENTRATOR IN THE AINSWORTH DISTRICT.



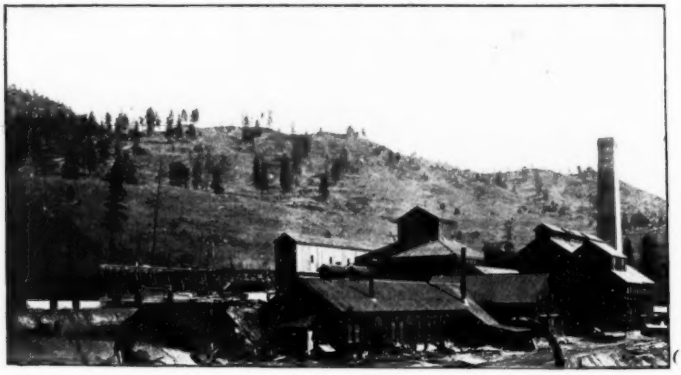
THE CANADIAN SMELTING WORKS, TRAIL, B. C.

posed of lumbermen, farm and railway hands and navvies, who nevertheless are as highly paid as their more experienced and qualified colleagues. Consequently when questions of dispute arise between capital and labour the men have the great advantage, of which both sides are aware, in that the expert miners can threaten to leave the country if a protracted settlement appears likely. In the recent Slocan labour troubles, the railways, it is affirmed, made good the losses sustained in the suspension of ore shipments by the transport of miners returning to the United States.

Another drawback to mining in the Slocan, although this condition may shortly be ameliorated, is the cost of marketing the ores. When the ore reaches the surface it is either sorted by hand or concentrated by machinery of the usual type. In the concentration there is often much loss of silver with the tailings, which is unavoidable; and so long as the silver-bearing minerals thrown off from the mill have a value less than the cost of freight and treatment, their rejection is explainable. But the silver thus deposited in the tailings may afterwards be recovered by other methods and yield a profit when shipped in a concentrated form, and when local smelting is established close dressing will become more necessary. After this preliminary dressing the ores are mainly consigned to Colorado for smelter treatment, the cost of carriage ranging from $11 to $19 per ton.

Although in the official reports the date of the commencement of copper production is given as 1894, as a matter of fact the first shipment of 100 tons of copper ore was made in 1888-9 from the Hall group of mines near Nelson, the value of the product being from 220.5

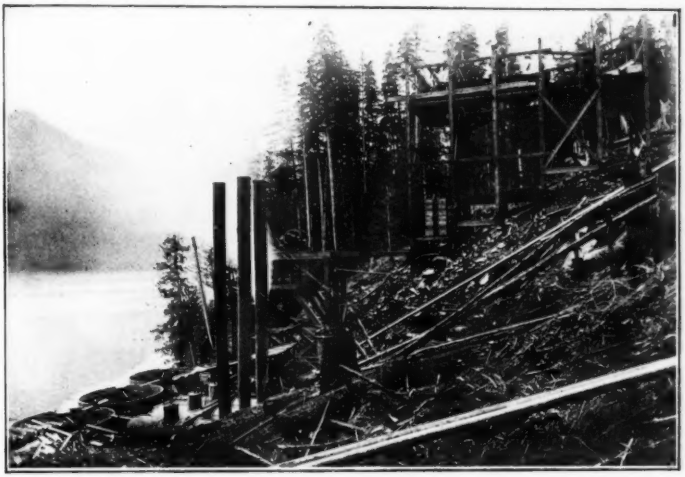
ounces silver and 17 per cent. copper to 574 ounces silver and 43.36 per cent. copper per ton. Also a shipment of 10 tons was made from Rossland in 1891 and of 700 tons in 1893. It is interesting, by-the-way, to note in connection with this first shipment from Rossland that the exceptionally high smelter returns of $84 per ton, or 3 ounces silver, 5.21 per cent. copper, and about 4 ounces of gold, practically established that camp. The consignment, packed over 12 miles of rough trail to the Columbia River, was sent from the Le Roi mine by a small syndicate of Spokane, Washington, speculators to whom the property was under bond, and who subsequently made a very large fortune as a result of their investment. Until the spring of 1895, however, the progress of mining in this district was comparatively slow, and it is said that no less than forty-two "experts" had in the interim condemned the camp as worthless. But in 1895, on the strength of a contract from the Le Roi Company to supply 75,000 tons of ore (on half of which a fixed charge of $11 a ton for freight and treatment was arranged), a land grant from the Provincial Government, and a bonus from the Dominion Government of $1 on each ton of ore smelted, a smelter was erected on the Columbia River at Trail and a narrow-gauge railway built between the mine and the works. As the crow flies this distance is only 4 or 5 miles, but to overcome the difference in elevation of about 2,100 feet between Trail and Rossland, the switch-



NEW SMELTER IN THE BOUNDARY CREEK DISTRICT.

back arrangement was employed, thus lengthening the line to over 11 miles. After the erection of the smelter, the cost of freight and treatment for nearly two years remained unchanged at $10 to $14 per ton, 95 per cent. of the assay value of the gold and silver being paid for and a deduction made of 1.3 from the percentage of copper present.

With the completion of their contract with the Trail smelter, the owners of the Le Roi mine erected works of their own immediately across the boundary at Northport, Washington, and succeeded in reducing their smelter costs to some extent. But with the acquisition of the Trail smelter by the Canadian Pacific Railway Co. freight and treatment charges were immediately cut down to $7 per ton. The chief cause of this reduction in costs was the great cheapening of fuel following the development of the Crow's Nest Pass coal fields. That the present treatment charges may still be considerably lowered is quite probable, for according to the report of the Le Roi Company last August, the cost of treatment at the Northport smelter was only $3.



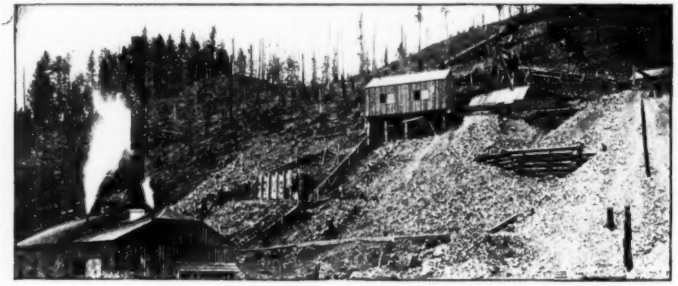
CYANIDE WORKS AT THE DOROTHY MORETON MINE, WEST COAST OF MAINLAND, BRITISH COLUMBIA.

The only instance of the adoption of the cyanide treatment in British Columbia.

In connection with the reduction of freight and treatment charges, the following table giving the actual yield values, according to smelter returns, of Rossland ores for the years 1894 to 1897 inclusive, is interesting as showing the increase of tonnage and gradual decrease of values as it became possible to extract profitably lower grade ores:

Year.	Tons (2,000 lbs.).	Gold (Ounces).	Silver (Ounces).	Copper.	Value.
1894	1,856	2.00	2.80	2.85%	$40.69
1895	19,693	1 60	2.41	2.10 "	35.67
1896	38,075	1.45	2.34	2.08 "	32.65
1897	68,804	1.42	1.60	1.32 "	30.48

In 1898 the average value per ton on a production of 111,282 tons was $22.80; and in 1899, $18 on a production of 185,000 tons. On this last there is still left a very fair margin of profit, and ore as low grade as $7.50 was profitably mined last year. In the past two years the Rossland mines have been equipped with costly machinery of the most recent design, and with electric power-transmission, the working of the mines on the contract system, and other innovations, the outlook for the future is very bright. To show further the condition of mining in the Rossland district, I append an excerpt from a recent report

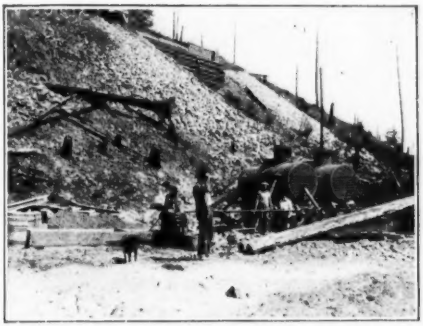


THE MOTHER LODE MINE, BOUNDARY CREEK DISTRICT.
The vein is more than 200 feet wide.

of the War Eagle Mining Company, comparing the cost of development and ore extraction from January, 1897, to December 31st, 1899:

Date.	Cost of Development per Ton of Ore Sold.	Cost of Ore Extraction per Ton of Ore Sold.	Total Cost of Mining.
January to September, 1897.....	$10.67	$2.11	$12.78
October, 1897, to September, 1898.	4.32	2.98	7.30
October, 1898, to September, 1899.	1.71	3.58	5.29
October, 1899, to December, 1899.	1.80	3.42	5.42

Up to the present time almost the entire metalliferous production of British Columbia has been derived from the two districts of Slocan and Rossland, but in the near future the productive area will be vastly augmented as a result of the development which has of recent years taken place in East Kootenay and also in what is known as the "boundary country," forty miles west of Rossland and immediately north of the international boundary line. The latter district is of exceptional interest on account of the very extraordinary size of the deposits found there, some of which are considerably more than 100 and, in one or two cases, 200 feet wide. The characteristic ore—an iron sulphide carrying gold and copper—is, however, speaking generally, of low-grade value, not averaging over $10 or $12 per ton. Accu-



BOILER PLANT, MOTHER LODE MINE, BOUNDARY CREEK DISTRICT.

These boilers were hauled in a distance of 65 miles on waggons.

rate sampling is a very difficult matter, as the ore will range from a barren pyrrhotite to another, of very similar appearance, carrying high gold values, while the copper contents in different parts of the same ore-body will vary proportionately as much. Where concentration is practicable it will undoubtedly be resorted to, and some very interesting tests in this direction have been made by a local engineer, who sends me the following particulars:

1. The magnetic oxides cannot be concentrated except by magnetic separators, followed by water concentration. With this plan concentration is very complete.

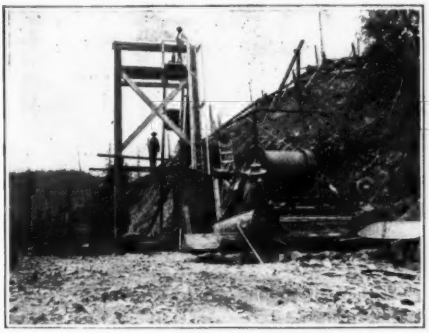
2. The calcite and siliceous ores can be concentrated, the first more completely than the second.

3. The proportion of gold saved in the concentrates will be close to, if not exceeding, 95 per cent. of all gold present in ore.

4. The proportion of copper saved will vary from 60 to 80 per cent., according to the degree in which formation of slimes can be obviated and the degree in which those formed can be concentrated.

5. The ratio of concentration will average about three tons into one.

Two large smelters are now in course of erection in the district, and it is stated that the charge for treatment will not exceed from $3.50 to $4 per ton, owing to the self-fluxing character of the ores; but even with this cheap rate, the utmost economy in working will need to be observed to ensure success. The completion last year of a railway



GALLOWS FRAME AND HOIST IN POSITION, MOTHER LODE MINE.

into the district acted as a great spur to industry, and in the last few months all the more developed mines have been suitably equipped with machinery. Previous to the construction of this railway, machinery and supplies were hauled in, a distance of 65 miles, over a rough mountainous waggon road, at the almost prohibitive charge of 2 to 3 cents per pound. While the conditions now existing are eminently

KNOB HILL AND IRONSIDES MINES, IN THE BOUNDARY CREEK DISTRICT.

more favourable, the future of the Boundary Creek district now rests largely with the metallurgist. Next year, however, should witness a very considerable output of both copper and gold from this region, and particularly of the former metal.

In East Kootenay, with an exception in the case of two or three large producers of lead and silver, very little productive mining has taken place; but the effect of improved transportation facilities as afforded by recently constructed railways is here also becoming very apparent in greatly increased activity. Exceedingly promising "prospects" of copper, gold, silver and lead are now being developed in several localities included in this area, but by far the most important work in course of progress is the opening up of the vast coal areas of the Crow's Nest Pass—undoubtedly one of the largest coal properties known. The measures occur in the heart of the Rockies and extend north and south a distance of 40 miles, stretching east and west 10

SLOCAN STAR MINE CONCENTRATOR SANDON B. C.

miles from the banks of Elk River towards the boundary line between Alberta and British Columbia. This area is, of course, reduced by the creeks which abound on the mountain slopes, and from which the coal measures have been eroded, but sufficient remains to constitute the coal fields unique in extent, as they are in richness. The geological report states that there are upwards of fifty workable seams of coal,

ELECTRIC LOCOMOTIVE COMING OUT OF A BRITISH COLUMBIA MINE.
The coal cars carry a load of 2 tons gross each.

varying in thickness from 4 to 30 feet and of these about one-third are cannel and the remainder bituminous. The tonnage of coal contained in this field was computed some years ago by Dr. Selwyn, then associated with the Geological Survey of Canada, after making all necessary reductions, at 75,000,000,000 tons. No less remarkable is the exceptional quality of the coal, which when coked gives a product that has no superior, as the following comparative* table of analyses of the principal bituminous coals of the world, adequately shows:

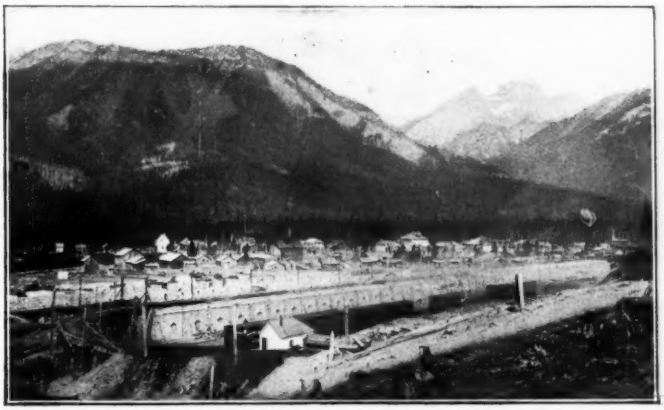
Locality.	Country.	Volatile Matter.	Fixed Carbon.	Ash.	Total Fuel.
Pennsylvania	U. S. A.	29.50	64.40	6.10	93.90
Virginia	"	33.68	57.76	8.56	91.44
Indiana	"	39.00	52.00	9.00	91.00
Illinois	"	36.59	59.47	3.94	96.06
Iowa	"	44.00	48.50	7.50	92.50
Missouri	"	34.06	50.81	15.13	84.87
Newcastle	England.	37.60	57.00	5.40	94.60
Staffordshire	"	37.86	59.64	2.50	97.50
Derbyshire	"	35.10	61.65	3.25	96.75
Yorkshire	"	35.67	62.08	2.25	97.75
North Wales	Wales	36.56	57.49	6.25	93.75
Pictou	Nova Scotia.	29.63	56.98	13.39	86.61
Sydney	Cape Breton	34.07	61.43	4.50	95.50

Crow's Nest Coal, taken on same basis as above.†

Locality.	Volatile Matter.	Fixed Carbon.	Ash.	Total Fuel.
No. 2 Tunnel—Coal Creek	21.02	76.25	2.73	97.27
" " "	25.00	72.50	2.50	97.50
Peter Seam—Martin's Creek	34.70	58.30	7.00	93.00
Jubilee Seam— "	31.70	68.30	4.20	95 80

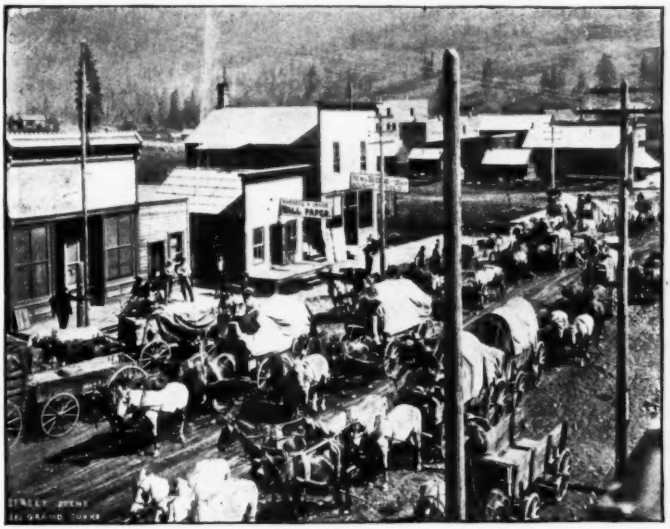
The immediate result of the operation of the Crow's Nest collieries and the establishment of coke ovens was, as I have already pointed out, the cheapening of the cost of local smelting. Until this fuel became available, the price paid for Welsh coke at the Trail smelter was from $15 to $18 per ton, while an inferior coke containing at least 18 per cent. ash, made from the Wilkington, Washington, cretaceous coal, was also supplied to these works at a cost of $13.40. Owing to the natural advantageous location of the East Kootenay deposits for cheap and economical working, the plentiful supply of timber for all mining purposes, and the abundance of water in the streams of the

* From a paper read before Am. Inst. M. E., by W. Routledge, 1885.
† Minister of Mines' Report, 1898.



TOWN OF FERNIE, SHOWING COKE OVENS UNDER CONSTRUCTION AND COMPLETED.

neighbourhood for power, the Crow's Nest Coal Company can produce "run of mine" coal for $1.25 per ton and sell and deliver coke to the smelters at $6, or less, per ton. At present the output is sufficient only to supply the local demand, but in a very short time the product of these collieries will find a ready market not only in the neighbour-

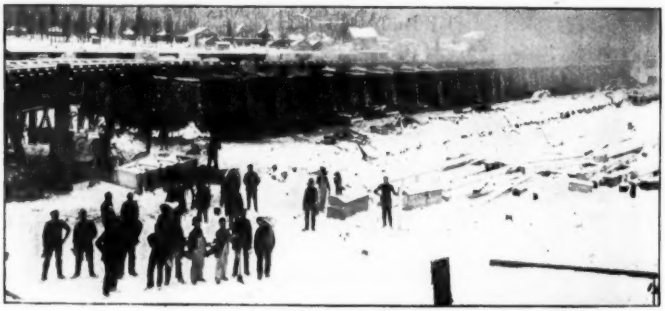


STREET SCENE IN GRAND FORKS, IN THE BOUNDARY CREEK DISTRICT.

ELECTRIC-DRIVEN 7-TON COAL LORRY, FOR CHARGING COKE OVENS AT FERNIE.

ing states, but Crow's Nest coal, it is understood, will also be purchased largely by the British Admiralty for use on the ships of the Royal Navy, so satisfactory have the tests proved.

There are other districts in addition to those to which I have made special reference, which, if they have not as yet contributed to the mineral production of British Columbia, promise ere long, on the strength of recent discoveries, to do so very appreciably. In short, there is no longer any question as to the exceedingly bright future in store for the mining industry of this country. Gradually the obstacles to progress which now appear so formidable will be overcome; the labour problem will present far fewer difficult points as the mining districts become more thickly populated and as the industry becomes more firmly established; mining and metallurgical costs will be still further reduced as conditions are more perfectly understood; and in proportion to the growth and importance the industry attains, so will be the readiness of capital, both British and American, to enlarge its scope in what must ultimately become one of the most important centres of mining activity in the whole of North America.



COKE OVENS OF THE CROW'S NEST PASS COLLIERIES, EAST KOOTENAY.

ELECTRICAL MEASUREMENTS OF WORK OR ENERGY.

By G. L. Addenbrooke.

IN making electric measurements it is not only that we measure electric quantities and actions, but that by means of measurements made electrically we are able to measure all sorts of other important things accurately.

For instance, measure the actions of a motor and its efficiency at different loads, and then set the motor to drive a lathe or some other tool or mechanical appliance. By watching and noting the readings of the electrical-measuring instruments we have at once an easy, accurate, and comprehensive method of observing exactly what the tool is doing under all circumstances and of the power required to drive it. We are, therefore, able to understand the working of that tool in a way which was not possible before, and not only are we in a position to see what is the most economical way of driving it, but how it can be used to the best advantage. It has never before been possible to investigate the working of the tools and other appliances by which man assists himself, in the way in which it can now be readily done by means of electric driving and measuring, by means of direct reading instruments, the current required to drive.

Again, the practice of testing engines coupled to dynamos—which, with proper arrangements, can be done continuously and with great accuracy and facility—has not only led in a few years to the production of dynamos of great efficiency, but it has enabled the output and working of steam and gas engines to be watched in a much more critical and detailed manner than has been possible before, and this has undoubtedly led to great mechanical improvements in steam engines, as well as to higher efficiency.

A working knowledge of the principles and method of making electrical measurements is, therefore, not useful merely in dealing with purely electric questions; by applying this knowledge intelligently we are enabled to watch, investigate, and control a great many other mechanical and industrial operations and chemical processes with great ease, and in a way which helps powerfully to secure the best results with the least expenditure in each case. Electrical measurement is also a ready means of testing the quality of many materials.

Further, electrical measurement in tramway and railway work has

enabled the working of the whole of such systems to be investigated and observed in the greatest detail, and there is no doubt that the rapid adoption of electric methods for tramway work and the rapid development of electric traction has been due to the fact that, from the first, ready means of measuring and observing what went on when a car was running, both as regards the engines, the dynamos, the lines, and the cars themselves, has enabled the working of the whole system to be understood and kept under observation, and has pointed out the nature of faults and the right way to remedy them in a manner which nothing else could have done.

Also, owing to improvements in thermometers and pyrometers worked on electric principles, we have a ready means of recording, either instantaneously or continuously, temperatures over an immense range. By this method accurate measurements are easily made of the temperature in any parts of boiler flues or other furnaces and in gas and steam-engine cylinders, so that we are able to observe in an accurate and comprehensive manner all this class of actions, which have hitherto presented many points of obscurity. We might speak of electric measurements in connection with the telephone, but space fails us to enumerate all of the indirect uses to which electric measurements can be put.

We must not, however, pass on without remembering another field in which electric measurements are of the greatest value, viz.: the field of telegraphy, particularly submarine telegraphy; and it is the more important to mention this, because it was really to fulfil practical needs in these fields that the modern and extraordinarily accurate systems of electric measurement were first developed. It is well worthy of note that the methods of electric measurement which we now look on as fundamental have not been developed so much in laboratories or for pure scientific purposes as by commercial engineers and for direct commercial uses. Developed for practical purposes, they have reacted on laboratory work and helped enormously in purely scientific research.

For instance, when it was first attempted to construct submarine cables of any length it soon became apparent that it would be of great advantage to have a much more sensitive and superior method of testing their insulation while being made than any at the time available, and also that very sensitive instruments were necessary to act as signaling devices when the cable was in use. To meet this need Lord Kelvin (William Thomson), developed the reflecting galvanometer. The extraordinary sensibility, simplicity, and accuracy of this instru-

ment not only effected what was required in connection with submarine work, but, at the same time, it enabled electrical measurements of several other kinds to be made with a remarkable degree of facility and accuracy.

Again, to measure the resistance of wires, which was important in commercial telegraphy, there was evolved what is called "the electrician's two-foot rule," namely, the Wheatstone bridge of Sir Charles Wheatstone. This is a means by which, preferably with the addition of a reflecting galvanometer, the electrical resistance of wires or bars of metal can be measured with extreme accuracy and facility. Then came the quadrant electrometer, an evolution from simpler forms, also one of the creations of Lord Kelvin—an instrument most useful for measuring the quality of insulating materials and which in improved forms will play a greater part in the future as an instrument for measuring alternating and multiphase currents than it has done in the past.

Lastly, should be mentioned the labours of the British Association Committee, who, in their endeavours to define and make an accurate standard of resistance for practical purposes, did much to improve and lay down the broad lines on which standard electric measurements should be conducted.

There have been also a host of other workers in these fields whose names will be found in the leading text books.

The purpose, however, of this article is not to relate history, but to say a few words on the principles of modern electric measurement to engineers and manufacturers or others who are not electric specialists themselves, but who are likely to come in contact with electric work or who might help themselves in their own business in some way by measurements made by electric means if they knew more about their scope and method.

The literature relating to electric measurements is exceedingly discursive, and facts and directions are scattered about in all sorts of places. This is due partly to the rapid advances continually made in the construction of instruments and in the methods of using them, and also, no doubt, to the very facts which have already been mentioned, namely: that measurements are made electrically for all sorts of purposes not directly electric, and therefore descriptions of methods of electric measurement and directions how to perform such measurements are found in connection with subjects not purely electrical.

It may consequently be asked: Are then, the methods by which electric measurements are made so very diverse? The answer is: No.

If once the principles on which electric measurements must be made are grasped, the methods are in principle both simple and few; but, at the same time, the varieties of instruments which have been designed for performing more or less similar functions in slightly different ways are numerous and rather confusing sometimes. For performing some of the more intricate kinds of measurement there may, however, be elaboration of detail.

The electric currents which it is necessary to measure in practice now are of two kinds—"continuous," that is, propagated continually in the same direction, and "alternating," that is, having the direction reversed continually. In telephony this reversal of directions occurs several hundred times a second, and often at a similar rate in modern telegraphy, while in electric-power work with alternating or multiphase currents the rate of change of direction is usually between thirty and fifty times a second.

Now the properties of alternating currents are in many ways different from those of continuous currents, except when the latter are starting or stopping, and therefore, although nearly all instruments which are used to measure alternating currents can be used also for continuous currents, it does not follow that instruments which can be used for continuous-current measurement are also adapted for measuring alternating currents. We shall therefore have to distinguish between instruments adapted to measure both classes of currents and those adapted for use with continuous currents only.

The modern view of electric currents is that electric energy is conveyed through the ether, chiefly in the neighbourhood of the wire, in a much greater measure than through the wire itself, the wire rather serving to define the direction in which the force will act than to carry it in the sense that water is conveyed in a pipe. It is important to bear this in mind in connection with electric instruments, because nearly all measuring instruments are based in principle on the utilisation of one or more of the actions which take place in the ether surrounding a wire when a current is being propagated along that wire, or on what was formerly called "action at a distance."

When an electric current flows in a wire it produces primarily two effects in the space surrounding it—the electrostatic effect and the electro-magnetic effect. The electrostatic effect is the same effect as that which you see if you tear up dry tissue paper in small bits and put it on the table and then rub a stick of sealing wax on your coat sleeve and afterwards hold it near the paper. The bits are sharply attracted and afterwards apparently repelled, though the repulsion is

only apparent and can be explained another way. A set of very valuable measuring instruments, which are likely to come into greater commercial use in the future than in the past, are founded on this action by substituting a light aluminum needle for the paper, and metal "quadrants" held near the needle for the sealing wax. When an electric circuit is properly connected to such an instrument a difference of electrostatic pressure is set up between the needle and quadrants and the needle is attracted more or less, according to the strength of the electrostatic pressure, just as the bits of paper are. This motion is made visible by attaching a pointer to the aluminum needle, or, for more delicate work, by using a small mirror attached to the needle, which reflects a beam of light onto a scale. Lord Kelvin and others have made instruments of this kind which are largely used commercially, and I have been at work for some years on a set of instruments of this character which are intended to form a standard set for central stations for both alternating and continuous-current measurement. For it is one great advantage of most instruments based on this principle that they can be used for the measurement of either alternating or continuous currents, and their readings are correct for both without recalibration. Owing to the delicacy of their action instruments of this class are, however, used mostly by skilled men. They are for many purposes the best kind of instruments to use, if the skill and knowledge required to make use of them properly are available, but where this is not forthcoming and a rather lower standard of accuracy is sufficient, other classes of instruments have hitherto usually had the preference. Joubert and Mascart's and Dr. Hopkinson's classic work on alternating currents was, however, nearly all done with instruments of this type. At present, however, such instruments are used as standards for checking the calibration and working of other instruments rather than for purely commercial measurement, except in special cases.

The second effect which is produced in the neighbourhood of a wire when a current flows is the electro-magnetic effect—that is, the space around the wire becomes circularly magnetised. The magnetic field, as it is called, falls off in strength as we get further and further from the wire. Mechanical effects can be produced in several slightly different ways by taking advantage of this action. For instance, if we pass a current through two wires, one of which is fixed and the other is hung or balanced near the first, but in such a way that it can move, when a current flows in the same direction through both wires they are attracted to each other; and, if this attraction is balanced by a

spring or a weight and the movable wire brought back so that it is just kept in its former position, the amount by which the spring is stretched or the size of the weight used can readily be made to measure the rate of flow of the current—or the "amperes," in electrical language. Instruments founded on this principle are called dynamometers and were invented by Weber. Siemens made a type in which a spring is used, which is very largely used commercially, particularly for alternating work, and Lord Kelvin has another type founded on the use of a weight, much used in England by manufacturers and in central stations as standard instruments. Though not as accurate as electrostatic instruments for alternating measurements, they answer for this class of work if proper precautions are used—in fact, it may be said that commercial alternating work has been almost entirely built up on observations made with instruments of this type. They are also largely used by electrical manufacturers in their test rooms for testing continuous-current plant as well as alternating; indeed, during the last twenty years they have been very intimately connected with electric progress. Their disadvantages are that they require manipulation in order to give a reading, and also need some skill in use. They are also rather troublesome to calibrate. They have one great advantage, which they possess in common with one type of electrostatic instruments; that is, that as they are double acting, one coil can be connected across a circuit with a high resistance in series while the other coil is inserted in the circuit. In this way the instrument can be made to read directly the watts, and thence the horse power, which is passing along a circuit; this is really what we want to know in many cases, and we thus get a reading which can be directly compared with an indicator diagram from an engine. Such an instrument will also measure directly the power taken by tools driven by a motor, or, in fact, any mechanical work done by an electric motor, and instruments of this class, whether founded on electrostatic or electro-magnetic principles, will undoubtedly come into much greater use. "Wattmeters," as they are called, are also instruments which are essential when dealing with alternating or multiphase currents, because with this class of current you cannot ascertain the power or the work which is being done by multiplying together the voltmeter reading of the pressure and the ammeter reading of the current, which can be done when the currents used are continuous. In the case of alternating currents, in addition to the current required for the work to be done there is the current needed to create the magnetic field in the ether surrounding the conductor and in any iron which it encircles, which

magnetic field is necessary for the propagation of the current. Consequently there is nearly always what is called a "lag" in alternating circuits, especially when driving motors, and if the current as shown by an ammeter is multiplied by the volts as shown by a voltmeter the result gives a figure for the watts or horse power which is in excess of what the power expended really is, so that this figure has been christened the "apparent watts." To get the true power we must use a wattmeter which has the interesting property of being able to disregard the part of the current which is not doing actual work and to measure only what is called "the effective component" of the current, or the working part of it. The perfect way this is done by an extraordinarily simple contrivance is one of the pretty things of physics, and one of the instances in nature where it looks at first sight as if there was a tangle which nothing would unravel and then, by some unlooked-for and simple expedient, the whole complication is completely resolved and can be dealt with in detail. To explain this intelligibly, though extremely interesting, would be to go too far into electrotechnics in this article, so we must pass on to other classes of instruments.

At two currents attract each other by means of their electro-magnetic action, so it follows that if a piece of soft iron is put near a current it is attracted to the strongest part of the electro-magnetic field, just as a piece of soft iron is attracted by a magnet, and this action can be intensified by making the conductor into a coil and putting the soft iron inside. Instruments so made can be used on either continuous or alterating circuits, but for continuous currents the current must only be passed one way, and for alternating circuits the instrument must be standardised for the particular frequency or rate of reversal of the circuit. Such instruments are not very accurate, but sufficiently so for many commercial purposes, and vast quantities are daily turned out for fixing to switch boards. Formed with a coil of a few turns and inserted in a circuit, they form ammeters or current measurers, and wound with a high resistance of many turns and put across the circuit, by calibration they are made to read by inference from the current passing the volts or electric pressure between the conductors of the circuit. They are apt to vary their readings after being in use for some time and also when they get hot, but as they are very cheaply made and stand some knocking about they have in the past met with much favour.

Where a little more can be paid for an instrument of higher accuracy there is another type which is rapidly coming into favour.

Unfortunately it will only measure continuous currents. Just as two currents act on each other by virtue of the attraction of the electro-magnetic fields they set up, and a current will attract a piece of soft iron, so the electro-magnetic field of a current will attract a magnet itself, the action being such as to cause the magnet, if movable, to tend to stand at right angles to the direction of the current. Consequently if we take a compass needle it will tend to be set north and south owing to the earth's magnetic field, but if we pass a current from north to south along a wire near the needle the needle would tend to be set east and west by this current, and the two forces each pulling according to their strength, the needle stands more or less diagonally and the angle of its movement from rest can be made to measure the strength of the current. Also the action of the current can be intensified by coiling the wire carrying the current round and round, over and under the needle in the same direction. In this way is made the instrument every electrical workman carries, called the "linesman's detector." In this way also is made the reflecting galvanometer already referred to and a number of other instruments.

Instruments of this class are very nice and very accurate as long as we have to deal only with the earth's field and the current to be measured, but they are troublesome and uncertain when used near moving masses of machinery or where other currents may be passing near. They have lately, therefore, been largely supplanted by what is called "the D'Arsonval, or moving coil" type of instruments. These instruments are founded on the same principle as those just described, but the action is reversed; instead of the magnet being small and moving and the coil remaining fixed, the magnet is large and fixed and the coil is small and hung between the poles of the magnet. The magnetic field is so strong and constant in this case that the instrument is not affected by the earth's field or moving iron masses near, and the instrument can easily be made to have the important property of being nearly dead beat. Weston in America has done much to improve and introduce this type of instrument, and other makers in England and on the Continent have followed his lead. The instrument, by the use of shunts or by a high-resistance winding, can be made to measure either electric pressure or "volts," or current as "amperes," provided the current is continuous. For manufacturers and others who want to make reliable electric measurements of power in the form of continuous currents in their business, but do not want to go into detail or cannot afford to keep a skilled electrician, this type of instrument is undoubtedly the most reliable and the easiest to

use. Many thousands are in use on central-station switch boards for lighting and tramway work.

We have now exhausted the types of instruments based on actions occurring in the ether or space surrounding a current, but before concluding we must notice another class of instruments which are very largely used in alternating and multiphase work and which can also be used with continuous currents. They are not founded on actions taking place outside the wire, but in the wire itself. When a current flows along a wire the wire becomes heated, and when heated most metals expand. Advantage is taken of this action in two different ways. In the first, a long, fine wire is mounted so that one end is fixed and the other free. When a current passes the wire stretches, and its elongation is measured on a dial by an apparatus something like that in an aneroid barometer. This is known as the Cardew voltmeter. In another form a short wire is stretched between two supports and the middle is attached to a light spring pulling at right angles; if the wire is heated a considerable movement of the spring occurs for a slight expansion of the wire, which is communicated to a pointer as before. Instruments of this class are not scientifically accurate, but except for the current wasted in them they make good switch-board instruments and are used in very great numbers, particularly on the continent of Europe for multiphase power work.

This completes the list of actions on which leading types of electrical measuring instruments are founded.

To make electrical-power measurements it is often sufficient to possess only voltmeters and ammeters, or perhaps wattmeters of suitable range. Unless, however, the measurements required are all of one class and within a limited and well-defined range, we must either go to considerable expense in buying instruments covering a great range, or adopt some expedient to increase the range of those instruments we have. It is in the use and adoption of such expedients that the skill of the technical electrician is needed. In a great many cases the deflections of the instruments go as the square of the currents or electric pressures dealt with. It is difficult in such cases to make one instrument have more than a three- or fourfold range—say to read between 1 ampere and 4 amperes, or from 100 volts to 400 volts. Consequently to secure accuracy and a large range, say 1 to 1,000 or more, we should need a number of instruments of each sort, the changing from one to another of which would be inconvenient, besides the expense involved. To get over these difficulties much measurement work is done by the help of "shunts," by the use of which only some

known part of the current or electric pressure is measured. By the employment of these an instrument can often be made to measure currents or electric pressures accurately over a range of a thousandfold or even more, if the instruments are of a sensitive type, such as reflecting instruments. It would, however, unduly extend this article to go into these technicalities.

When once the principles are grasped the measurement of electric currents or electric energy within certain ranges such as are often used in a single trade is an easy matter, and if the apparatus is set up by a skilled man and occasionally looked over, an observer with very little knowledge can make all the observations which are required in the daily round of business.

In undertaking electric measurement it necessarily follows also that we get a clear insight into and a working knowledge of all other electric actions, such as those which take place in dynamos and motors, and from this standpoint the laws and methods of their construction and use can easily be understood and grasped.

Although we have no special organ which enables us to touch, see, or feel most electric actions, it is a curious fact that within the last half century methods of electric measurement have been perfected which enable us to indicate clearly all that is going on with as great accuracy, if necessary, as is attained by the chemical analyst in his laboratory who can weight to one one-thousandth of a grain. In fact, just as we can make a series of balances which will weigh anything from less than one one-thousandth of a grain to 50 or 100 tons, so we can make a series of electric instruments which will measure accurately from one one-millionth of a volt or ampere or less to 10,000 or 100,000 amperes or volts or watts or more, and by the intelligent use of shunts one set of suitable instruments may be made to include nearly if not all this range.

It has been said that "Science is measurement." The electrician or electrical manufacturer or station superintendent therefore, if he avails himself of the resources at his disposal, is in a position to conduct his business on very scientific lines and to ascertain very exactly all that he is doing. He has thus exceptional opportunities for advancing surely and avoiding mistakes and faults, while many other trades may usefully avail themselves of electric measurements to inform themselves exactly as to the working and action of the apparatus or plant they turn out or the power they use, and so can obtain the most economical and desirable results.

THE IRON SITUATION FROM A BRITISH POINT OF VIEW.

By J. Stephen Jeans.

ERY little more than a year ago, I was present at a meeting of the Civil Engineers in London, at which my deceased friend, Mr. Jeremiah Head, and his son, Mr. A. Potter Head, submitted a joint paper on the Lake Superior iron-ore mines. In that paper it was stated that the approximate cost of producing a ton of Bessemer pig iron in Middlesbrough, the chief centre of the iron trade of Great Britain, was £2.12.2, whereas in Pittsburgh (U. S. A.) it was not more than £1.12.5½. The selling prices of ship-plates were at the same time said to be lower in Pittsburgh than in Middlesbrough by 24s. 3d. per ton; of steel billets and blooms, by 22s. 6d. per ton; and of heavy steel rails by 9s. 9d. per ton.

Since that time many things have happened. The prices of pig iron, steel plates, billets, blooms, rails, and wire rods, have advanced about 100 per cent., and in some cases by 150 per cent., not only in the United States, but in more than one European country as well. The prices of raw material have advanced in a more than corresponding degree. On the Tees, coke for blast furnace use has gone up from 14s. to 26s. per ton, Spanish hematite ore has gone up from 13s. to 21s. 6d. No. 3 Cleveland pig iron, which has been sold in some previous years as low as 29s., has gone up to nearly 80s. per ton, and so, *mutatis mutandis*, with most of the other products of our mills and forges. In the United States, the advance of prices has been even greater than in Great Britain, and in some continental countries it has been more considerable than in either Great Britain or the United States.

The developments of the past sixty days make it plainly evident that the high prices still ruling in the iron and steel markets stand as a menace to the prosperity which the engineering industries throughout the world have been enjoying for several years past. We are especially pleased, therefore, at being able to present this timely, conservative, and well-informed paper from the pen of the distinguished Secretary of the British Iron-Trade Association. That the price of pig iron is the barometer of trade has become an accepted truism. And rarely indeed do we have the opportunity to see the essential facts of the iron-trade situation throughout the world stated so calmly and so clearly, at a time when all eyes are watching the quotations for iron and steel, and when thoughtful men throughout every branch of the engineering indus-

At the present writing we appear to be at the parting of the ways. The boom is not absolutely spent, but it has exhausted a great deal of its force, and there are many evidences that the near future will be likely to bring with it considerable changes—perhaps changes that will be as surprising as those that have already been named. Very few foreign orders have been booked in Great Britain during the last week or two, which is an indication that foreigners are waiting for lower prices. The British ship-building trade is much less brisk than it was, and not many new orders are coming to hand. American manufacturers are giving greater attention to their foreign customers, or hoped-for customers, and have lately been quoting plates and bars, delivered in Australia, for about the prices that are being quoted in England at

tries seem to be waiting for that concession in prices which will make possible the onward march of constructive enterprises. Mr. Jeans tells us that within a year the prices of iron and steel products have been more than doubled in every market of the world. He might have added, also, that the prices of iron ore, notably in the Lake Superior region, have also been more than doubled within the same period; and among both British and American coal-mining companies every effort has been made to force up the price of both coal and coke. The logical and necessary effect has been a practical check to orders for new business, not alone in the ship-building industry, in railway construction and improvement, and in building operations, but wherever iron and steel figure in the cost of construction—which means practically everywhere. But Mr. Jeans shows us also that the normal increase in consumption of iron will undoubtedly employ the world's productive capacity if there be no halt in constructive and manufacturing enterprises. He might have added that the sure promise of early and unprecedented development in South Africa, in China, in Russian Asia, in Australia—indeed, throughout the world—makes certain a long era of uniform and uninterrupted activity in all branches of the iron and steel trades. But in the face of these conditions, reports from every quarter of the world tell of halting industry, orders withheld, factories and works closing down, and widespread waiting for the necessary and inevitable decline in the market prices for iron and steel. Surely if ever the managers of the great consolidations and combinations had an opportunity to show wisdom and foresight in vindicating the arguments which have been used to justify their formation, they have it now. The obvious demand of the hour is for a *radical* reduction in prices, which will meet the markets, insure orders enough to keep iron and steel works steadily busy, and thus renew the forward movement of this remarkable industrial era. And it must not be supposed that the policy of gradual reductions can meet the situation. The evils born of a sudden advance in prices ranging from 100 to 150 per cent. cannot be cured by conceding an occasional 10 per cent. That would be like cutting the dog's tail off an inch at a time—not only painful, but certainly perilous. For each forced reduction serves only to whet the anticipation of its certain successor, and in the end values are forced below the normal range. — THE EDITOR.

works. Similar indications might be multiplied, but that appears to be needless. The problem now presented for solution is whether these evidences mean merely a passing lull, or whether they point to a world-wide repletion, which is likely before long to develop into a general glut. There is probably no maker of iron or steel throughout the world who would not give much for an inspired reply to this question.

There is no gainsaying the fact that the iron and steel manufacturers of Europe are beginning to look with anxious eyes to the United States. It seems to those who think they can discern the coming events casting their shadows before that the sword of Damocles is suspended over the heads of those who are now enjoying a feast of fat things. That sword is the near competition of the United States. It is, moreover, a two-handed sword, for it cuts to the very dividing asunder of joints and marrow by an admitted capacity to produce more cheaply than European countries, and it also presents the very formidable aspect of threatening to dump a vast surplus on neutral markets, on terms that are not competitive at all. To be perfectly candid, this latter is the form of competition of which the people of Europe are most afraid, because they are most powerless to resist it, and this remark, of course, applies more especially to Great Britain, which is a free-trade country.

It should, I think, be specially emphasised that British ironmasters do not stand in fear of the United States because of their admitted inability to compete with American manufacturers, but because they live under a different economic system and one which does not allow them to arrange for the regulation of prices to home consumers, in order that they may export, at any price they can get, a large surplus product. This is done both in the United States and in Germany, owing to the system of protection which guarantees to the manufacturers of those countries a virtual monopoly of their own markets. Many of my friends in the iron trade here have told me again and again that they would not fear the rivalry of any country under equal conditions; but when one country offers free markets and an open door, and others shut the door with a bang, the conditions are not equal, but very much the reverse. This is the greatest source of discouragement to the British manufacturers to-day.

Nevertheless, there is an obvious limit to the length that a manufacturer can go in dumping this surplus on foreign markets. Every European nation and most other nations, excepting Great Britain and the Scandinavian countries, have protective tariffs, which may be raised when American products become too strongly competitive.

Great Britain is likely to remain free. It would require little short of an earthquake to move the people of this country from the rock of free trade, to which they have anchored their economic barque. So far, therefore, as England is concerned, Americans have her markets at their feet if they are strong enough to occupy them. If they occupy them too much there may by and by be some sort of reprisal in the form of countervailing duties. On the other hand the competition of the United States up to the present time has not hindered, but has rather helped, the British iron trade by aiding it to execute orders that it was more or less unable to overtake, and by supplying much-needed raw materials for the wire, hoop, tin-plate, sheet, and other industries.

The development of the system of combinations or so-called consolidations of great manufacturing establishments must in the near future exercise a much more potent influence on the competitive conditions of the United States, in relation to Europe, than hitherto. Practically, it comes to this—that the control of the great iron and steel industries of the United States is not now vested, as it was up to a recent date, in the hands of many different firms who often had very little in common, but it is subject to the caprice and the controlling operations of half-a-dozen powerful corporations whose fusion, or united action, would virtually create a monopoly market and establish monopoly prices within the limits of the United States. There would appear to be no adequate reason why the prices of commodities, so far as they are controlled by these corporations, should not be raised to the utmost figure that the tariff will allow, and that may roughly be taken as 40 per cent. of the declared value of the products in American ports, which would mean at least 50 per cent. more than the prices quoted in Europe by European manufacturers.

When we look back on the experience of the past we find that the world's demands for iron have been so steadily progressive that it is impossible to doubt that they will continue so in the future. There are no substitutes for iron, nor are any likely to be found. All anticipations that the demand for iron would fall away have, in the long run, been falsified by results. Twenty years ago it was believed that the Bessemer process, which was estimated to yield a metal six or seven times more durable than iron, would practically ruin the iron trade, by the limitations it would be certain to impose upon the quantity of metal required for permanent-way renewals; and yet more material is used to-day for that purpose than has ever before been called for. Many similar examples could be quoted. At one period it is iron for railways, at another steel for steamships, at another for machinery,

at a fourth it is the electrical field that is opened up to the iron-makers, and yet again, the consumption of iron is greatly stimulated by the increased use of both iron and steel in buildings, in rolling stock, and in a hundred other directions. Now, in estimating the wants of the future, it is important to remember that all these demands are cumulative, and that any particular source of consumption, once opened up, is not ephemeral, but has come to stay. This surely means that every succeeding period will show a great increase of consumption.

So far as can be ascertained at present the total increase of production of pig iron in 1899 over 1898 was about 4,000,000 tons, of which 3,848,926 tons were contributed by the countries named in the following table:

MAKE OF PIG IRON IN THE LEADING IRON-MAKING COUNTRIES, 1898 AND 1899.

Country.	1898. Tons.	1899. Tons.	Increase. Tons.
Great Britain	8,681,071	9,305,319	624,248
United States	11,773,934	13,620,703	1,846,769
Germany	7,288,343	8,117,594	829,251
France	2,525,075	2,567,388	42,313
Russia	2,221,709	2,671,624	449,915
Belgium	979,755	1,036,185	56,430
Totals	33,469,887	37,318,813	3,848,926

The wonderful place which the United States holds in this table is its most striking feature. Equally remarkable is the record of the steel industry of the United States for 1899, reaching, as it does, to more than 10,000,000 of tons. The comparatively slow progress made by other countries suggests that the United States, Great Britain, and Germany will mainly supply the world's wants in the future, or, at least, in the near future, and they may find they have quite enough to do.

For it is possible, after all, that competition, in the ordinary sense, will be unknown in the near future. It may easily be that there will be an absolute scarcity of materials—that it will take the utmost efforts of which all iron-making countries are capable, for many years to come, to supply the material and legitimate demands of the world, and that more countries, if any there be, that come to our aid may be regarded as the kindest of friends rather than as industrial enemies.

A good deal of anxiety has been felt during the last two years as to the available supplies of iron ores and fuel. The total world's consumption of iron ores in 1899 was probably more than 90,000,000

tons. Of this quantity, I take it that the United States contributed more than 22,000,000. But in all countries alike very exceptional efforts were made to increase the output so as to overtake the greatly stimulated demand. These efforts are still being continued. Spain has been ransacked from one end to the other, in order to increase the available supplies. France is opening up new sources of supply in Greece, North Africa and elsewhere. The Germans have sought to acquire almost a monopoly of the supply of Swedish Lapland—within the Arctic circle—for a number of years to come, and have concluded arrangements which point to their belief that iron ores are likely to become increasingly scarce. This is a very general apprehension, and if, as I believe, it is justified by the facts, then it seems to be probable that this condition may mainly determine future supremacy. Madame de Stael once observed that "Providence fights on the side of the biggest battalions." In the war of commerce and industry, it is conceivable that Providence may in the future seem to interpose on behalf of the nation that has the largest available supplies of cheap iron ores.

I shall have written this short article to little purpose if I have not succeeded in making clear my conclusions that the iron consumption of the world must continue to grow, and that, in all probability, at an increasingly rapid rate; that there must, nevertheless, be ups and downs, which will afford opportunities to enterprising countries, which, like the United States, are liberally endowed with natural resources; that we must be prepared for any sort of surprises in the future, as the past has proved the special liability of the iron trade to radical changes of prices and competitive conditions; that national economic systems are the most potent factors in facilitating or retarding successful rivalry, and that the difficulty most to be feared in the future is that of finding adequate supplies of cheap and suitable iron ores.

EDITORIAL COMMENT

History is making so fast in China that it is impossible to foresee the outcome of even the few days between the printing of these pages and their appearance in completed form. Correspondence from the empire, dated barely four weeks ago, made no mention of anything unusual, or, at most, contained only casual mention of "disturbances in the north, not likely to spread to any serious extent." Now the condition grows in gravity day by day, and properly takes first place in public interest.

Gen. Wm. Barclay Parsons' striking article upon the engineering development of China, which leads this number, is based, of course, upon the assumption that a stable and reasonably enlightened government is to exist in the country. So long as disorder reigns, so long especially as the reactionary forces are violent, enterprise and capital will stand aloof. But that these conditions will long prevail cannot be believed for a moment, and the indications are strong that out of present events will spring some very definite and radical change in the political administration of the empire. This is the conviction expressed by General Parsons in a most interesting interview upon which these paragraphs are based. His intimate acquaintance with Chinese affairs makes his opinion significant.

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It is highly unlikely, General Parsons thinks, that the present disturbances will end, as did the Empress's *coup d'état* of two years ago, in a mere party shifting of goverment. At that time the crisis was brought on by over zeal of the reform element, in whose hands the Emperor was a tool, serviceable for his vested authority, but personally a nonentity. The rapid succession of progressive edicts —extending even to one ordering the cutting off of the queue—outpaced the advance of the people. The Empress Dowager, working with the reactionary party, was marked by the reformers for arrest, and the Emperor's order therefor was placed with the military governor of Pekin for execution. He, seeing more chance of personal profit in trading on his orders than in executing them, informed the advisers of the Empress. She returned hastily to Pekin, made terms with the general by which he swung the army to her support, and the first canto ended with the turning of the tables, the removal of the weakling Emperor, and the beheading, flight, or departure into exile of the reform leaders.

But the reacting wave of conservatism, in turn, seems to have raced too far and to be tumbling to destruction. Europe and America, tolerant of China's administration of her own politics, have been roused to needed action by disorders which the government could not or would not quell, and by anti-foreign demonstrations and outrages on the life and property of Caucasians which China was unable or unwilling to check. How far any particular foreign influence may have instigated the Boxer uprising, or may affect the attitude of the Chinese authorities toward it, is a question lying too deep down in the fascinating but tangled foreign politics of China to be guessed at now. It is certain that whatever influence Russia may have in China is with the conservative party, and and that the progressive party is Russophobe. The report that the Empress has taken refuge in the Russian Embassy is disturbingly suggestive But is is not clear what Russia would gain by forcing a crisis yet. When her plans for Eastern

Siberia and her Trans-Asian railway are completed, it may be different

But while it may be forcing an interpretation to see any evidence of an *entente* in the Empress's asylum under the Russian flag, her flight suggests the immediate fall of the existing government, and in its stead—what? General Parsons sees two possible endings of the affair, with no present indication strong enough to determine which will be brought about.

The first is the preservation of the integrity of the empire under joint control, the establishment of a stable Chinese government, of course by the progressive party, backed, supported (and probably largely inspired) by the Powers. The second is the dismemberment of China, with a general scramble for coveted territory, and very possibly a resultant war between Russia and Japan, or, indeed, a European war. That either solution has enormous difficulties needs no explanation. The situation is is one of tense, and even painful, interest.

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In case of the partition of China, Russia would naturally claim the north and northwest; Germany would consider Shan Tung her share; England would seek the Yang Tse valley; France, Ton King and the south; Japan, the coast territory on the Eastern Sea; the fragments left over would be for the rest.

England has, of course, much to lose and nothing to gain from such a contingency. In pursuit of her fixed policy, she would "open the door" even to nations which would close their doors to her. The United States would be in even worse case, as they would not have even a "sphere of influence." Japan might gain some military advantage at the expense of commercial opportunity, and even the strategic gain would be more than counterbalanced by Russia's establishment. For Germany, advantage and disadvantage would be on a nearly even balance. It is probable a wise policy should place her with England, America, and Japan in a firm and positive stand for the integrity of China, a stable and strongly supported national government, and the "open door" throughout the empire.

France's interests are not large enough to give her an intense interest in the struggle; she could afford to take her chances. But Russia represents the other side; her interests, at all events as she sees them, demand her exclusive control of the territory which she covets It remains to be seen whether England, America. Germany, and Japan, standing together, can carry the day. It remains to be seen, also, if the Anglo-Saxon nations, by wisdom and calmness, can avert the danger of a Russo-Japanese war, which many authorities consider so near.

* * *

The problem is full of new quantities which cannot yet be estimated. One is the United States, suddenly stirred by over-sea interests, and with large military forces soon to be freed from service in the Philippines. Another is Japan, feverishly interested in her new economic expansion and her new navy, sharply jealous of Russia smarting under the diplomatic defeat which lost her Port Arthur, and under the Korean concessions. A third is the reported rottenness of the Russian organisation, military as well as civil, which some excellent judges believe would cause her to break down under the strain of war, and beyond doubt would give the victory to Japan. A fourth, and possibly the determining one, is the seasoned armies of England, as yet engaged in South Africa, but in all probability soon to be freed for work elsewhere.

In our own opinion, the most active danger is that Japan will break out of bounds to have a dash at Russia, but that if this can be averted Europe and America will come to an agreement by which at least nominal autonomy for China will be preserved—for the present. It is a new "Eastern question," but the sick man of Asia may live as long as the sick man of Europe, without actually bringing his prospective heirs to blows over his death bed.

REVIEW OF THE BRITISH PRESS

The Status of the Naval Engineer.

WAR is becoming more and more a matter of engineering science. That this is a fact is being generally recognised by the great body of civilians who furnish the means by which armies and navies are created and maintained, and who look to those armies and navies to protect and aid them. At the same time there is great reluctance on the part of those branches of the service not devoted to engineering to admit the engineer to the rank and authority to which the changed conditions have brought him. This is especially the case in the navy, and the present state of affairs in the Royal Navy with regard to the engineers is well shown in the important paper recently read before the North-East Coast Institution by the vice-president, Mr. D. B. Morison.

In this paper the importance of the engineer as a factor in the predominance of British sea power, so essential to the existence of the empire, is set forth in unmistakeable terms.

"The strategical, tactical, and combatative powers and functions of a ship of war are conceived, defined, and executed by the administrative and executive officers of the Royal Navy, but the responsibility for its creation, in the constructional sense in accordance with the stipulated requirements, and for its ability during its active life to respond readily and effectively to the directing will of its commander, may be correctly said to devolve upon the engineering profession.

"It is the engineer who designs and constructs the entire machinery of a warship. It is the engineer who is responsible for the generation of the all-essential steam, and for the vast aggregation of complicated machinery for its varied utilisation, and again it is the engineer who is responsible for the maintenance of the mechanism of the entire armament in a state of efficiency."

The growing importance of the engineer department with relation to the executive department is well seen when it is understood that in 1878 the total personnel of the engineering department was one-fifth that of the executive, while in 1898 it had increased until it formed one-half as much as the executive department. This is only what might have been expected from even a superficial examination of the increased adoption of mechanical appliances in naval warfare, but notwithstanding this great and natural increase the engineer department has had no extension of its powers.

"In spite of its undoubted importance, and the fact that it comprises approximately one-third of the total personnel of the navy, the engineering branch is not represented upon the Board of Admiralty, which is composed entirely of political and naval executive officers. Therefore, the engineer-in-chief, who is the responsible head of the department, is placed in a weak and subordinate position, which checks the full and free exercise of his experienced judgment in conformity with what he believes to be necessary for the attainment of the highest possible state of efficiency, throughout the one primarily essential department of the steam navy."

After touching upon the advanced requirements made upon the naval engineer in the course of the development of the steam navy, and showing the high degree of educational attainments now included in the training, Mr. Morison goes on to show how important are the duties and how great the responsibilities of the naval engineer.

An important point to be noted is the fact that the number of engineer officers is by no means adequate for the correct and complete fulfilment of the multifarious duties to be performed. This is readily seen by a comparison between the navy and the merchant marine. Comparing H. M. S. "Terrible" with several Atlantic liners of

similar size and power, it appears that this, one of the greatest battleships of the navy, carries 1 fleet engineer, 5 assistant engineers, and 1 artificer engineer, added to which are 18 engine-room artificers, a total of 25 in all; but the artificers, although mechanics, carry no direct responsibilities. As neither the chief nor his principal assistant can take regular watches, this leaves but 6 engineers available to stand watch.

The "Lucania" carries 22 engineers, of which 10 hold first-class, and 3 second-class Board of Trade certificates, besides 2 electricians, 1 boilermaker and 24 greasers, in addition to firemen, trimmers, storekeepers, and donkeymen. There are 7 engineers on each watch. These proportions hold good throughout both services. On ships of the Royal Navy the ratio of engineers to men ranges from 1 to 21 in battleships, to 1 in 37 in ships of the "Terrible" class, and rises as high as 1 to 48 in some destroyers. In the merchant marine the ratio of engineers to men is about 1 to 8.

The present position of the engineers is most ill-suited to their relative importance, being included in the civil branch of the service, the whole of which is subordinate to the executive or military branch, and the officers of which receive no military rank or title and are not empowered to award punishment to their departmental subordinates for any offence whatever. Apart from the humiliating position in which this places the men upon whom the navy must depend for its efficient action, it conduces to undermine their authority in a way which may be hereafter realised only after bitter experience.

The engineer is no longer a non-combatant, and the title "fighting engineer," appropriately applied to the same branch of the service in the United States Navy, is equally fitting in the Royal Navy.

America now gives positive rank to her naval engineers, and under the new personnel bill will soon have done away with the anomalous condition due to the old state of affairs, and it is to be hoped that Mr. Morison's paper will arouse an agitation which will cause a like change to be made in the Royal Navy, without the necessity of a sharper lesson to those in power.

Distant Electric-Power Transmission.

THE recent paper of Professor George Forbes, presented before the Institution of Electrical Engineers, contains much of interest, in view of the prominent part which the author has taken in the development of long-distance transmission work.

The first portion of Professor Forbes's paper relates mainly to a condensed account of some of the leading plants in various parts of the world, including those at San Bernardino, California; Snoqualmie Falls, Washington; Padermo, Italy, and Rheinfelden, in Germany. In addition to these Professor Forbes gives an account of the general arrangement of the plant at Niagara Falls, for which he assumes the main responsibility, and for which he shows great practical success. The great point which has been demonstrated by the generators at Niagara is the success of the low frequency there adopted, and, in general, the great dimensions of the plant.

The author touches on the transmission to Buffalo, discussing the manner in which, by the use of Mr. Scott's device, the current is changed from two-phase to three-phase, and speaks with especial commendation of the ingenious automatic cut-outs, which have been of such high value in preventing interruptions of supply on the Buffalo transmission.

An interesting feature in this connection is found in the question of the regulation of the turbines. The first three turbines were regulated by a purely mechanical governor, but the later ones were provided with a more sensitive mechanical governor. It has been found in practice that the supply at Buffalo is most steady when the two turbines driving the dynamos are regulated, one by a sensitive and the other by a coarser governor.

Passing from the consideration of individual plants, Professor Forbes proceeds to discuss the questions of Lord Kelvin's law of economy, to the use of boosters and phase rectifiers, to the relative merits of different kinds of polyphase systems, to overhead and underground conductors, and to the use of aluminum.

In regard to the application of Kelvin's law, the data on which we choose the current density by this law depends on (1) price of copper; (2) price per annum of

the horse power; (3) interest on the price of copper. In this connection the following meanings of (2) and (3) may be noted. When using water power which is unlimited compared with the demand, (2) is the price per annum of generating the power. When the water power is limited and the demand unlimited, (2) is the selling price of the power. If the copper be mortgaged, (3) is the interest paid on the mortgage, say 4 per cent. If the copper is paid for out of capital, (3) is the interest to be paid in dividends on the capital, say 15 per cent.

Kelvin's law was originally announced as being true only when the percentage drop in volts was small. By using boosters along the line the drop in volts can be corrected, as Professor Forbes shows by an example. In the original paper tables are given showing the results with and without boosters when the line is considered as a whole, or is divided into two, three, and four sections; together with corrections for capacity, self-induction, temperature, and sag.

By the use of boosters it is possible to reduce the weight of copper in some cases to less than one-half of what was possible by the old system; a very important feature when power is cheap and the distance of transmission great.

Passing briefly over the questions of induction factors and phase rectifiers, choice of polyphase systems, and material and character of conductors, Professor Forbes proceeds to make some suggestions as to a British type of power transmission, differing somewhat from what appears to be becoming the normal arrangement.

There appears to be a tendency at present to crystallise plans and to settle into grooves which do not always seem to be the best. Tenders from various firms for the same installations resemble each other very closely, except as to details. Three-phase currents generated at 2,000 to 3,000 volts are used, with frequencies from 25 to 40. Separate turbines for the exciters, with the main turbines and generators on horizontal shafts, are the rule. The transmission pressure varies between 24,000 to 30,000 volts, and two complete and independent sets of conductors are employed.

Professor Forbes suggests that the arrangement which suits a transmission line which is also a distributer of power does not necessarily yield the best results for a plant transmitting the whole power to a long distance; that the high-pressure continuous-current system is very suitable for certain cases; that the two-phase alternating current is to be preferred over the three-phase in many cases, and, that the horizontal shaft for turbine and dynamo might well be replaced by a vertical shaft, as at Niagara, Rheinfelden and elsewhere. Manufacturers and contractors in Great Britain have not given the subject of long-distance transmission plants sufficient attention, and they run a risk of being passed over entirely in the future as they have been in the past, unless they put themselves in readiness to undertake such work. Although there are but few great water powers in Great Britain, immediate progress may be expected in connection with the development of power at the coal pits. If this is done a large share of the field in the colonies, where water-power is available, may be acquired, and British manufacturers secure a position in this important and growing trade which until the present has been almost entirely in the hands of other countries.

Gas-Driven Blowing Engines.

AMONG the papers presented at the recent meeting of the Iron and Steel Institute was an interesting one by M. Adolphe Greiner describing the construction and performance of a large gas-driven blowing engine at the Cockerill works at Seraing, Belgium. This is the first blowing engine worked by blast-furnace gas ever employed in any iron works, and hence the account was received with great interest.

Blast furnace gases have been the subject of animated discussion for several years, but until recently the trials have been made with only small engines, the effort being rather to demonstrate the suitability of the gases for direct use, than to install a working plant. About two years ago the Cockerill establishment started a 200 horse-power gas engine, using furnace gas, and driving a dynamo for lighting purposes, and this engine has been working satisfactorily day and night ever since.

The new blowing engine is of much

larger capacity, having been designed for 600 horse power, and this power has been considerably exceeded in actual service. The dimensions of the engine are necessarily large, the gas cylinder being 4 ft. 3 in. in diameter, and the air cylinder 5 ft. 7 in. in diameter, both being 4 ft. 7 in. stroke, 80 revolutions per minute.

This engine has been running since November, 1899, and it has recently been the subject of a series of very precise experiments to determine the consumption of fuel, as well as the useful effect of the blowing engine. The tests were conducted by M. Hubert, of the Liége School of Mines, in the presence of M. Witz, Mr. Bryan Donkin, Professors Meyer, of Göttingen, Dwelshauvers, of Liége, and others.

The general details of the trials are given in M. Greiner's paper, from which it appears that a most excellent thermal efficiency was obtained. The gas was tested by two methods, the calorimetric bomb tests of Professor Witz giving a mean calorific power of 984 calories per cubic metre, while the Junker calorimeter showed a mean value of 860 calories.

The engine was first tested simply as a gas motor, the blowing cylinder being disconnected and the power measured on a friction brake. Under these conditions the mean effective power developed was 575 horse-power, the maximum attained being 670 horse power. The consumption of gas under these circumstances was 111.4 cubic feet per brake horse-power, or 90.36 cubic feet per indicated horse-power. When subsequently operated as a blowing engine the mean power ranged from 561 to 725 horse-power, using gas of a thermal power varying from 876 to 1,000 calories per cubic metre. The gas consumption in these trials averaged 101 cubic feet per horse-power effective, or 82.35 cubic feet per indicated horse-power.

These figures give the remarkable thermal efficiency of 30 per cent., this being the ratio of the power developed to the mechanical work equivalent to the heat of combustion; the heat balance being as follows:

Heat converted into work....	30	per cent.
Heat lost in water jacket.....	50	" "
Heat lost in exhaust.....	20	" "
	100	

Since the thermal efficiency of the best steam engines is only about 12 per cent., and that of most blowing engines is much lower, this is a great advance, and if the ratio of the work done in compressing the air to that produced by the combustion of the gas be taken, we find that the net efficiency of the machine, including the mechanical efficiency of the whole, is about 22 per cent., even taking the higher thermal value for the gas.

These figures are of general interest, but as a matter of fact economy of gas is secondary to effective performance, since the gas is practically a waste product. A fair indication of the satisfactory performance of the engine is found in the fact that plans for three more such engines, of 1,200 horse-power each, are now being made.

Contrary to previously expressed opinions, there has been little or no trouble from dust, the gas being taken directly from the furnace and only cooled before delivery to the engine.

M. Greiner emphasised the great economy attained by the use of blast furnace gases, showing that, apart from the gas required for heating the blast, there is produced, by a furnace making 100 tons a day, sufficient gas for 2,000 horse-power. Taking this as equivalent to 2 tons of coal per hour, or 48 tons per day, and the price of coal at 10s. per ton, the saving would be £24 per day, or £7,200 per working year. Putting the cost of the engines at £6,000, and the building at £2,000, the whole would be nearly paid for at the end of the first year.

Practical Applications of Metallography.

THE study of the molecular constitution of metals, as revealed by etched sections under the microscope, has been considered in many quarters as a laboratory method, of little immediate service in practical work. That this is not the case has been known to a number of conscientious workers in this field on both sides of the Atlantic, and the practical value of the method is well brought out in the papers of Signor R. Schanzer, recently presented before the Institution of Naval Architects, upon the so-called mysterious fractures of steel shafts.

There has been a number of sudden

fractures in shafts and other steel structures which have been subjected to shocks and vibratory stresses, and some of these have been of a most perplexing character, attracting the attention of many of the most authoritative investigators. Most of these fractures represent nothing else than so many cases of brittleness, more or less marked, a phenomenon for which our present knowledge is quite inadequate to account, except in a very limited number of cases.

A very startling feature of such fractures which ought to be noticed is that many sudden breakages in shafts and other structures occur in materials which have been accurately tested before use, and in which the ordinary physical tests uniformly pointed to the best quality of metal. After such a structure has been working continuously for several years in the most satisfactory manner, fracture may suddenly occur, while at the same time no visible evidence of deterioration has appeared up to the very moment of failure, to give warning of the coming danger.

This question of the fatigue of metals has been studied by many eminent authorities, but no definite solution of the matter has yet been reached, and it can by no means be considered as settled. It is, however, possible, by microscopic examination to discover what changes may have occurred in the physical structure of the metal, and it is the result of such examinations which forms the basis of Signor Schanzer's paper.

Signor Schanzer first discusses the views of Professor Arnold as to the effect of the relation of the pearlite, or true steel, present to that of the ferrite, or iron, upon the strength and endurance of the material. A microscopic examination of a piece of steel, under proper conditions, will reveal the manner in which the two constituents are related. When the pearlite and ferrite are closely interlocked with each other the conditions are favorable to the tenacity of the steel, but where the particles are not so interlocked, and there are distinct junction lines between the two constituents, there is liability to rupture under vibratory stresses, because the cohesion or adhesion is inferior to that of interlocked constituents.

Bearing these facts in mind, a study was made of forty-one samples of steel suddenly broken, micrographic examinations being made of samples polished both normal and parallel to the axis of the shafts, and in every case the structure was marked by a distinct separation of ferrite and pearlite, the latter gathering in different points of the section, so that areas of different hardness were formed. In the case of specimens polished parallel to the axis of the shaft, the areas take the shape of elongated stripes. This structure gives rise to hair cracks running in the same direction on the external surface of the shaft.

It is evident that such a constitution is not conducive to strength or toughness. Sharp junction lines between two materials of very different hardness must necessarily cause a tendency of the two surfaces to slip upon each other under vibratory stress. Such surfaces, separating two substances of very different hardness, are certainly surfaces of weakness. In examining specimens of steel to discover this structure it must be remembered that the characteristic stratified structure is only clearly noted on samples polished parallel to the axis. A similar method of examination ought to be also applied to other steel structures, such as plates, rails, etc., in which cases the direction in which the samples are to be polished must be modified according to circumstances.

While it is very important to be able to detect, by microscopic examination, such a structure in steel as is conducive to the formation of cracks, it is still more important that the cause of such structure be discovered, if possible, in order that it may be prevented. In the present state of our knowledge the complete causes cannot, unfortunately, be ascertained, and to enable any thorough study of the subject to be conducted would involve a knowledge of the history of each sample, including chemical composition, manner of working, heat treatment, conditions of stress, etc., etc., and these can only be obtained when the studies are made in direct connection with the work of the manufacturer. There is every reason to believe that the stratification is dependent upon the direction of forging in the case of shafts, and of rolling in that of plates and rails. The percentage of phosphorus present is also a probable

factor, and by uniting the tests of metallography with those of the chemical and physical laboratories, these and similar relations should be capable of demonstration.

The serious nature of disasters attending the breakage of shafts, whether at sea or ashore, should make it imperative that every precaution be taken to insure sound metal, and it seems probable that future specifications may include metallographical examinations among the requirements for acceptance.

Heavy Motor Vehicles for Common Roads.

WHILE the chief development of the automobile on the Continent has been in the direction of pleasure and touring vehicles, nearly all the original efforts in England have been towards the more useful if less conspicuous merchandise wagon.

This question formed the subject of an important paper recently presented before the Institution of Mechanical Engineers, by Professor Hele-Shaw, and as he remarked at the beginning, there are strong reasons for thinking that the subject of mechanical propulsion upon common roads has now reached a point where it deserves the very careful consideration of mechanical engineers.

After mentioning the manner in which improvement in this line had been retarded by the law of the "man with the red flag," which made it impossible for any self-propelled vehicle to proceed at a rate of more than four miles an hour upon common roads, Professor Hele-Shaw goes on to show first, how the development of railways has influenced the progress of the nation, and, second, how the proportional increase in terminal charges renders it essential that some improvement be made. "Cartages and terminals exceed the haulage charges over short distances by rail, whilst they become only a very small percentage of the whole when the distances are considerable. It must be obvious that a motor vehicle, which can travel from any one point to another, which absorbs the short cartages into one straightforward journey, and which absolutely eliminates railway terminal charges, has a wide and promising scope for application." By plotting curves showing the relations between conveyance and terminal charges for various distances, it appears that up to 40 miles there is a field for a system of conveyance in the working of which terminals are not included. To this economy must be added the sanitary advantages to be gained by the elimination of the horse, these being well-known, and becoming gradually appreciated.

In discussing the progress which has been made towards the solution of the problem Professor Hele-Shaw divides the subject into three main sections: 1. The behaviour of the wheel upon the road; 2, steering and turning; 3, motive power, including transmission and gearing; these being followed by a summary, together with an appendix of tables.

The behaviour of the wheel is a very important feature, as the injurious effects of a rough road, due to the bodily vertical movements of the whole vehicle, can only be obviated by providing some means of intercepting the shock, either between the wheel and the vehicle, or between the wheel and the road. The former method is found applied when springs are used under the body of the car, but these do not relieve the periphery of the wheels from the shocks which must ultimately destroy them, and hence the best result is obtained by placing an elastic medium between the wheels and the road.

The pneumatic tyre acts in a two-fold manner; it not only interposes an elastic cushion between the irregular road and the vehicle, but it does so by a continuous spring of compressed air extending round the periphery of the wheel. The compression of this air absorbs the obstacle, and thus involves no further work in the compression of the main spring itself. "The advantage of the pneumatic over the iron tyre increases rapidly as the speed increases. Taking 100 as the force required for the pneumatic tyre and iron tyre at a slow speed, the resistance of the iron tyre increased at an ordinary trot to 126, and at a quick trot to 164, and probably if the matter had been investigated for the ordinary speeds of an autocar, the relative resistance of the iron tyre would have been found to rise even more rapidly."

So far as steering and turning are concerned, nearly all vehicles use the principle invented by Ackermann in 1818, both

steering wheels being independent, pivoted so that their normals intersect on a point on the line of the axles of the driving wheels. For turning, a differential gearing of the so-called "jack-in-the-box" type is interposed between the driving wheels, to permit them to accommodate themselves to the required conditions.

In regard to motive power, three kinds are at present in use, viz., oil, steam, and electricity, although it by no means follows that some additions may not be made to the list.

Of these the oil engine, or rather, the internal combustion engine, has been found the best for light motors and pleasure vehicles, but it has not yet been applied with complete success to heavy vehicles. The use of electricity depends upon the life and capacity of the battery, and under ordinary working conditions it is found that repairs amounting to about one-fifth the original outlay are required after six months' running. Distances greater than 40 miles, and speeds greater than 10 miles an hour, involve prohibitive dead-weight and excessive discharge rates. Although it would be very desirable to use electricity in view of the advantage of driving the four wheels of a lorry independently, there has as yet been no satisfactory heavy electrical motor brought to the practical stage.

It is therefore necessary to consider that the really available motor is the steam, or external combustion, engine. Many varieties of steam engines have been applied to driving vehicles, but these are merely adaptations of existing types, and the special features are those involved in the construction of oil-burners, boilers, and condensers. Illustrations of many of these are given in Professor Hele-Shaw's paper, and for the details the reader must refer to the original. The burners, which are chiefly for heavy oil, involve some device for vaporising the oil by the heat of the flame, means for regulating the air supply being also supplied in most instances. The boilers, with but one exception, are of the water-tube type, this possessing in a high degree the two essential properties of lightness with strength, and capacity for responding promptly to a sudden demand for steam. The flash boiler, of which the Serpollet is the principal example, involves the use of very thick tubes containing a very small quantity of water, injected continuously and flashed instantaneously into steam.

In all cases the necessity for using a small engine involves its operation at high speed, and hence either gear wheels or chain gearing must be used to bring the speed down to the required extent. Some of these include variable speed gearing, but this is not so essential with steam as with internal-combustion motors.

A number of important tables, showing data from actual operation, are appended to the paper, and from these it appears that the cost of a motor wagon carrying four tons of freight ranges from 3.9 pence per ton mile for 20 miles, to 1.84 pence for 50 miles, the corresponding costs for railway transport being 11.54 pence and 4.37 pence, respectively.

The paper contains very much of value which the limited space prevents from being noticed here, and it should be consulted by all interested in the problem of economical transport.

The Disposal of Town Refuse.

THE question of the disposal of town refuse is one of growing importance, and for this reason the paper of Mr. Brierly Denham Healey, read recently before the Society of Engineers, is of more than passing interest.

In view of the discussion which has been given to the economy attained by the utilisation of heat from the destruction of refuse, the main point is apt to be overlooked. The real question at issue is the complete and inoffensive destruction of refuse. If the heat produced by the combustion can be utilised, so much the better, but the main thing is the complete destruction of the refuse. "The first duty of all sanitary authorities is to collect and dispose of their refuse matter with as little inconvenience as possible to the residents of their own districts, and without causing any nuisance to them or to the residents of bordering districts."

This is the first essential, and if after the complete and inoffensive destruction it is found practicable to recover any of the energy which would otherwise pass off in the form of heat, this should be regarded

in the light of a by-product saved, and not as a main result of the process.

A common error is to attempt to pass as much refuse as possible through the smallest number of furnaces, with the consequence, in many cases, of causing a nuisance by imperfect combustion; and, where steam generators have been used, the furnace gases have been forced through them at the greatest velocity, altogether regardless of efficiency or economy.

Although a number of destructor plants have been put in operation in various places in England, it is difficult to compare the results. The refuse in different places differs greatly in heat development, ranging from 200 i.h.p. per ton for Birmingham refuse, to only 12 i.h.p. for refuse from Bath, so that it is not easy to make satisfactory comparisons.

Destructors may be divided into three classes: (1) Those which are intended only to burn the refuse as a sanitary measure, without any attempt to utilise the heat, and from which the clinker is mostly shot into old pits or quarries. (2) Those which have machinery for dealing with a large portion of the clinker, and for which some of the otherwise waste heat is used for generating the steam necessary for driving the same. (3) Those in which every effort is made to utilise fully the effluent gases of the furnaces, and to produce a vitreous clinker, suitable for many useful purposes.

Assuming that a modern plant is intended to destroy the refuse completely, to utilise as much of the heat as is consistent with complete combustion, and to produce a fully vitrified clinker, the following features should be given attention in construction. A high temperature being necessary for the attainment of complete combustion and thorough vitrification of the residue, forced draught is now generally adopted, and hence stacks need not be higher than 60 feet, so far as draught is concerned, but in practice it has frequently been found necessary to carry the height much further, in order to disperse the discharged gases. Some of the older plants had stacks 150 to 180 feet high, one being 300 feet high, but with complete combustion and proper dust catchers such heights are altogether unnecessary.

Too many furnaces should not be connected to one boiler, since the draught is impeded, and the combustion and temperature proportionally lowered. The flue area should be large enough to give a slow velocity to the current and permit the dust particles to be precipitated, but too large a section causes loss by increased radiation, and a mean must therefore be used. Mr. Healey recommends a minimum area of 24 square feet for a plant of not more than twelve furnaces, with 2 square feet extra for each additional furnace. For forced draught there is required about 2 pounds of air per pound of refuse burnt, or say 485 cubic feet per minute for a consumption of 10 hundredweight per hour, but with natural draught double this amount is required.

In the early destructors the boilers were set directly over the fires, and consequently the combustion was imperfect. Modern designs surround the combustion chambers with double brick walls and provide radiating brick surfaces so as to permit temperatures of 2,000° F. to be readily maintained. By preventing the entrance of cold air this high temperature can be kept up and the refuse completely incinerated, the highly heated gases passing from the combustion chamber to the boiler only after the combustion is fully completed.

Mr. Healey discusses the methods of removing and utilising the clinker, showing its applicability to the manufacture of cement, to the production of paving slabs, and to the preparation of bacterial sewage purification beds.

Water-tube boilers are now very generally used in connection with destructor furnaces, and moveable grate bars have been found desirable to break up the clinker and keep the air spaces open. A number of arrangements of furnaces and boilers are shown in the paper, with data as to their practical performance. In nearly all cases the value of the steam generated goes far to neutralise the cost of destruction of the refuse, this depending naturally upon the character of the material. The average result shows that 1 pound of refuse will evaporate 1 pound of water, and that the net cost of destruction ranges from 2.5 to 11.5 pence per ton.

Blast-Furnace Gases in Gas Engines.

In these columns there recently appeared a review of the progress which is being made in the development of large gas engines, and it may now be of interest to notice some reports of practical experience in the use of blast-furnace gases in these engines, which have appeared in *Stahl und Eisen*.

Herr F. Werndl, of the Friedenshütte, in Silesia, says that when one considers the scepticism and doubt expressed about the use of blast furnace gases in gas engines only a short time ago, it is astonishing what rapid progress has been made in this field. The chief difficulties anticipated were the amount of dust in the gases, their small percentage of combustibles, their varying composition and the aqueous vapour they contained. The dust, which caused the most apprehension, is found in practice to be much less of an obstacle than was anticipated. The gases pass through various cleaners which remove nearly all the dust, and the small amount which gets into the cylinder is practically all blown out again.

There was concern felt about the low percentage of combustible, as it was thought this would necessitate an increase in the size of the engines, and might cause difficulties in the ignition of the charge. But actual experience has dissipated these doubts. The varying composition of the gases is almost always equalised when more than one furnace is in blast. But even if there be only one furnace, the governor of the engine takes care of irregularities in the gas by admitting a greater or less amount to the combustion chamber. Finally, the water vapour may indeed lower the calorific intensity of the gases, but practice shows that the calorific intensity is ample, when the gases are adequately compressed, to produce all necessary power at the moment of explosion.

At the Friedenshütte plant, the blast-furnace gases have to travel a distance of about 500 meters before reaching the engines, which gives them a good opportunity to get rid of their dust. After leaving the furnace, the gases pass through several stand-pipes and five dry cleaners, then through a long pipe to some more stand-pipes, and then to the "coke-scrubbers," which latter, however, are now left empty, as the porous coke became clogged up with the fine dust and stopped the flow of gas. From the scrubber, the gas flows through a sawdust purifier into a gasometer, from which it is led to the engine.

While the amount of dust suspended in the gases after passing the dry cleaners at the furnace is 5 grams per cubic meter (2.2 grains per cubic foot), it has fallen to 0.6 or at most 1.6 grams per cubic meter (0.26 to 0.7 grains per cubic foot) by the time the sawdust purifier is reached, and after leaving the latter there is only a few thousandths of a gram of dust in each cubic meter.

Before passing the sawdust purifier, the moisture amounts to about 13.5 grams per cubic meter (5.9 grains per cubic foot), and after passing through, to about 5.5 grams (2.4 grains per cubic foot). An analysis of the gases before entering the engine gave 28 to 30 per cent., by volume of CO, 6 to 7 per cent. of CO_2, and 3 to 3.5 per cent. of H. The amount of gas consumed by the engines varies. The greater the load, the less, in proportion, is the gas consumption. The 200-horse-power engines, when carrying a load of only 90 horse power, use 6.6 cubic meters (231 cubic feet) per horse-power hour, but when loaded up to 177 horse power, the consumption of gas sank to 3.8 cubic meters (133 cubic feet) per horse-power hour. It can thus be seen that at full load these engines would require only 3.5 cubic meters (123 cubic feet) per horse-power hour. In this plant are two 200 horse-power gas engines, each connected by means of a

leather coupling to a dynamo which furnishes continuous current for lighting, and two 300 horse-power gas engines, each rigidly coupled to a rotary current generator.

At the Donnersmarckhütte, also in Silesia, there is, according to Herr Müller, a 100 horse-power Körting gas engine, fed by blast-furnace gases. This engine has one cylinder, operates with four strokes to a cycle, and has valve gear, and a governor which regulates the amount of gas used. The diameter of the cylinder is 50 centimeters, the length of stroke 85 centimeters, and the number of revolutions 130 per minute. Directly coupled to the engine is a shunt-wound, continuous-current dynamo, also built by Körting.

The blast-furnace gas used has a calorific intensity of about 1,000. An analysis gave 31 per cent., by volume, of CO, 7.8 per cent. of CO_2, and 3.4 per cent. of H. The gases are cleansed of dust by passing through a "scrubber" and a sawdust purifier. As at the Friedenshütte, it was found that coke in the scrubber soon became clogged and hindered the flow of gas, so that now water is sprayed through the gases in the scrubber, collecting the dust particles and carrying them off through a siphon. This works very well. The amount of dust is not great, being about 1.5 kilograms per day for the 100-horse-power engine. The final cleansing is done by two layers of sawdust, 10 to 15 centimeters in thickness, which are renewed every four weeks.

At full load the engine uses 2.6 cubic meters (91 cubic feet) of gas per horse-power hour; at three-quarters load, 2.7 cubic meters (95 cubic feet); at half load, 3.1 cubic meters (109 cubic feet), and at one-third load, 3.5 cubic meters (123 cubic feet). It follows from these figures that the machine should be designed so as to run at nearly full load in order to produce the best results.

In comparison with steam engines, it may be said that the gas which used in a gas engine would produce 3,700 horse power, would, if employed as fuel for boilers, generate only 1,000 horse-power with the steam engines in common use in metallurgical works. Even if the best modern triple-expansion steam engines were used, they would develop only half as much power as the gas engines, with equal amounts of gas, and at the same time the first cost would be much higher. These large gas engines are found most serviceable in running electric generators, which supply current for every required purpose, forming a most flexible and efficient system, and one peculiarly adapted for mining and metallurgical work.

Some German Machinery at the Paris Fair.

GERMANY is making a splendid showing at the Paris Exposition. Her work there has been done with that systematic thoroughness which is aiding her so much in the great commercial struggle going on all over the world. Germany is very much in evidence in many parts of the Fair, but nowhere does she show to better advantage than in the foreign section of Machinery Hall. One of the interesting exhibits there is the great Carl Flohr travelling crane, which has helped not a little to put the German section in the advanced state which has been remarked by so many observers. This crane spans the entire width of the hall, its upper arch conforming approximately to the curves of the roof trusses, and runs on tracks laid at the floor level close to the walls. Besides the upper arch, which at its highest point is 22.12 meters above the floor, there is a horizontal stiffening girder with a clear height of 12.5 meters. This horizontal girder carries the crane carriage, as well as platforms, and is connected with the center of the arch by a vertical latticed post, which helps to support the horizontal girder and stiffens the whole structure.

The crane is supported by columns which, toward the bottom, spread out fore and aft to a distance of 8 meters, in order to afford a long enough base and prevent any possible danger of upsetting. Each column rests on four trucks, which have two wheels apiece, all eight in line ahead. The wheels are flanged at the middle and run on two T rails, laid with their centers 11.8 centimeters apart. The crane has a span of 27.6 meters, and as it travels the entire length of the hall, 107 meters, it commands every part of the floor, and is high enough to clear everything. The 26 horse-power electric motor which drives the structure up and down the hall, is placed in the gallery on the horizontal girder, and

its motion is transmitted to the wheel axles by means of horizontal and vertical shafts and bevel and worm gearing. The speed along the tracks can be raised to 30 meters a minute. The travelling carriage is driven by an 8 horse-power motor placed upon it, and it also carries two motors, of 18 horse-power apiece, which work the lifting chain. The carriage can run at a speed of 18 meters a minute, and a load of 30 tons can be lifted at the rate of 2.4 meters a minute. The motors get their current from a conductor, supported on brackets on the side of the hall, by a sliding contact.

Among the machines which have been erected by this crane are four sets of generating apparatus which constitute the German part of the great power and lighting plant in Machinery Hall. Each set consists of a steam engine directly coupled to a dynamo.

These few points, taken from the *Zeitschrift des Vereines Deutscher Ingenieure*, *Glaser's Annalen*, and the *Elektrotechnische Zeitschrift*, touch on only one portion of the German machinery exhibit. Some of the installations referred to are illustrated in Mr. Donner's article appearing elsewhere in this issue (pp. 529-542). As a whole, it shows the enormous advance made by Germany in the development of technical industry, and may well give her commercial rivals cause for serious consideration.

Electric Locomotion on European Railways.

WHILE electric locomotion is assuming increasing importance in American railway work, it may be of interest to cast a glance at some European developments in that line, as set forth by Herr Frahm, in *Stahl und Eisen*.

The Paris-Lyons-Mediterranean Railway has for some time been making experiments on its main line, near Paris, with an electric locomotive which gets its current from a storage battery placed on a tender. This locomotive has a forward running axle and two rear driving axles 2.2 meters apart, on each of which is a continuous-current motor. The locomotive itself carries only a small auxiliary battery, which serves to excite the field magnets, to work the air compressor, and to furnish light. It is doubtful, however, whether accumulators will be used permanently. They have been employed principally as a convenient source of current for experimental purposes, as motors could be tested in this way without making any changes in the railway itself.

In Germany, on the 52-kilometer connecting link of the Pfalz Railway system, between Worms, Ludwigshafen, and Neustadt, accumulator cars with two 50 horse-power motors have been in operation since 1897. Two ordinary third-class carriages have been fitted up as motor cars and carry under their seats a battery large enough to drive the car, together with one or two trailers, at an average speed of 45 kilometers an hour. The total weight of a motor car is 24.4 tons, which includes 9.3 tons of battery and 4.1 tons for the two motors. The battery for one car consists of 124 hard-rubber cells, and when discharging at the rate of 150 ampères has an average electro-motive force of 225 volts and a capacity of 200 ampère hours. The average energy consumed by one motor car, with a seating capacity of 38, hauling one trailer weighing 10 tons, empty, and having seats for 50 persons, is 832.5 watt hours per train-mile. On the 23-kilometer standard-gauge line between Stuttgart and Plochingen an accumulator motor car has been in operation since 1897. This is also a converted third-class carriage, which is fitted with two 35 horse-power motors and carries a 5.8-ton battery in a box under the car body, between the trucks. It runs at a speed of 30 kilometers an hour on a line which has heavy grades and several curves.

In Italy the prospects seem promising for a wholesale electrical equipment of the railway system, on account of poor and expensive coal and cheap and abundant water-power. The first standard railway to be run electrically was the 13-kilometer section of the Mediterranean road, between Milan and Mouza, where an accumulator system was put in operation in February, 1899. This system was used in order to avoid making any changes in the road itself. The cars are 17.8 meters long, have 64 seats for first and second-class passengers, and rest on two four-wheel trucks. Each truck carries a powerful motor, and the cars attain a speed of 45 kilometers an hour. There are 130 cells of

battery, which are charged in one hour, and which then run the car for 80 kilometers. The Adriatic Railway is also about to equip its 42-kilometer section between Bologna and San Felice with large accumulator cars which can carry 60 passengers.

Among standard railways which are operated by the trolley system may be mentioned the road between Düsseldorf and Crefeld, 22.5 kilometers in length, which carries both passengers and freight, and besides handling the traffic between its terminal points does a large local business between intermediate stations. Other German roads, as well as Austrian, Hungarian, French, and Italian, are being equipped with trolley and third-rail systems, the latter seeming to have the preference where the traffic is heavy.

Switzerland, however, is the most active European country in the electric-railway field, as the natural conditions are so particularly favourable. Its many mountain streams and waterfalls furnish an economical and plentiful source of power, which is being rapidly developed. There is a great deal of attention being devoted to branch lines and lines into side valleys, where the heavy grades make rack railroads necessary. In some cases high passes and even mountain tops are reached by electric railways, as, for instance, the completed Görnergrat road, near the Matterhorn, and the Jungfrau road, now only partly finished. The principal standard-gauge electric road in Switzerland is the one between Burgdorf and Thun, 41 kilometers in length, opened last summer.

Rainfall and Sewers.

In a recent issue of the *Zeitschrift des Oesterreichischen Ingenieur und Architekten Vereines,* Herr Eduard Bodenseher describes a practical and thorough method of determining the amount of rainwater which it is necessary to provide for in the construction of sewers and drains.

Every plant has, naturally, to be treated individually, but when adequate data, particularly complete plans and profiles of the district in question, are given, the system of sewers and drains can be designed in a thoroughly scientific manner.

Among the preliminary points which have to be determined, the local rainfall is most important. But it must be remembered that the heaviest strain on the capacity of a sewer system is not caused by the quiet, steady, long-continued rains, but by sudden, violent downpours which are of comparatively infrequent occurrence and which last only a short time when they do happen. It becomes, then, of interest to see what the chances are of these heavy rainstorms. Of course, this depends very much upon the geographical position of a place, it having been observed that violent rains are heavier and more frequent in mountainous regions than in a flat, low country, and, also, that the more violent such a storm is, the shorter, the less frequent, and the less extensive it becomes. It would be uneconomical to build sewers large enough to hold the greatest possible amount of rainwater that could ever fall, and various practical considerations will determine the rainfall which is taken as the basis of calculations. From many observations made in European cities, extending over periods of years, Herr Bodenseher concludes that a fair general rainfall figure for these heavy showers is 90 liters per second on a hectare (0.00036 inch per second), lasting from 15 to 20 minutes; or, in extreme cases, in large, closely built-up cities, 100 liters per second per hectare (0.0004 inch per second), lasting 30 minutes.

But the total rainfall is one thing, and the amount which flows off from the surface generally quite another. It is only the latter which has to be taken into account, and here again observation and experience have provided figures for the use of the engineer. The rain which falls may be divided into three parts: that which evaporates, that which is absorbed by vegetation and the earth, and that which flows off on the surface. The first may be disregarded, for the heavy rains with which we are concerned almost always occur when the air is so saturated with moisture that the evaporation is negligible.

The proportion of water absorbed varies very greatly, from more than 90 per cent. in wooded regions, to nothing on roofs of buildings, but in designing a sewer system, particular attention must be given to the conditions which obtain in cities.

Herr Bodenseher uses some coefficients which are given by Kuichling as the re-

sult of observations in American cities, the number in each case meaning the proportion of water which flows off on the surface.

1.0 for roofs;

0.8 for sidewalks, asphalt, wood pavement and stone pavement with water-tight joints;

0.5 to 0.6 for well-trodden paths, rough stone pavements, and macadam;

0.4 for unfrequented foot-paths and gravel roads; and

0.2 for dirt roads, gardens, lawns, and railroad tracks.

These figures enable us to determine the greatest amount of water to be provided for, by taking the rainfall on any area and multiplying it by the appropriate coefficient, which will give the total discharge of water from the surface of that area.

But there is one other point to be taken into account before fixing the size of the sewers: The rainwater does not flow off instantaneously, but takes time to reach different points of a sewer net-work, and if this time, for any point, is greater than the duration of the rainfall, the flow from the area near the point will have ceased before the water from the most distant parts arrives, and so the rate of discharge past this point will not be as great as the total rate of discharge from the drainage area. This retardation in discharge is particularly emphasised by Herr Bodenseher, who takes it into account in his calculations, and who lays out discharge curves for many points of a sewer system, so as to determine the sewer sections with scientific accuracy. He has applied his method practically in the design of a sewer system for Troppau, in Austrian Silesia, with such success that he received the first prize in a competition instituted by authorities of that city.

Railway Improvements About Paris.

AT this time, when the tide of travel sets so strongly toward Paris, it may be of interest to review a paper by Herr Frahm, in a recent issue of *Glaser's Annalen*, where he describes some of the improvements which have recently been made in the terminal facilities of the railways entering the French capital.

The terminal stations in Paris, up to a short time ago, were the following:

1. The Eastern Station, the terminus of the Eastern Railway.

2. The Lyons Station, the terminus of the main line of the Paris-Lyons-Mediterranean Railway, which has also another station, the Vincennes, the terminus of its branch line to Vincennes.

3. The Orléans Station, on the Place Walhubert, the terminus of the Orléans Railway, which has a second station at the Luxembourg Garden for the branch line to Sceaux.

4. The Montparnasse Station, where the Brittany lines of the Western Railway terminate, and which also accommodates the Government Railway.

5. The Moulineaux or Champ de Mars Station, which also belongs to the Western Railway, and serves principally to accommodate the suburban traffic with St. Cloud and Sèvres.

6. The St. Lazare Station, the terminus of the Western Railway lines which come from the lower Seine and Normandy.

7. The Northern Station, the terminus of the Northern Railway.

All these stations are connected by the Paris Belt Line, which encircles the whole city in the vicinity of the fortifications, and was finished in 1867; but it is only within the last ten years that the railways began to penetrate the real center of the town, which is that part lying on both banks of the Seine between the Hôtel de Ville on the east and Champ de Mars on the west.

In 1892 and '93 the Sceaux branch line was extended about 2 kilometers in tunnel and open cut to its present terminus at the Luxembourg Garden.

The Orléans Railway soon had an opportunity to take advantage of the experience it had gained in this work. For many years its station on the Place Walhubert, on the left bank of the Seine, in the southeastern part of the city, has been getting farther and farther away from the heart of the town, which is moving steadily westward, and so the Orléans Company has been anxious to extend its main line toward the west. Its chance came when it was enabled to acquire a large piece of government property on the Quai d'Orsay, on the left bank of the Seine, opposite the Tuileries, and about 4 kilometers below the Place Walhubert. Since then it has

been running a two-track extension along the left bank of the Seine to the Quai d'Orsay, where it has built a new terminal station. This extension lies partly in tunnel and partly in a subway right under the pavement. This subway lies so close to the Seine, that it can have numerous side openings, above high-water mark, giving directly on the Quais, which afford ample ventilation. But as the tracks at the Quai d'Orsay Station are all underground, it was found expedient to use electric locomotives of the so-called Hoboken type, with four driving axles, on the extension These locomotives have a power of 500 kilowatts, and can haul a 200-ton train at the rate of 35 kilometers an hour.

As already mentioned, the lines of the Western Railway terminate at the three stations of St. Lazare, Montparnasse and the Champ de Mars. The latter is conveniently situated, but has heretofore been of little importance, as it was used only by the Moulineaux line, a suburban road to St. Cloud. The two others, though, are at a considerable distance from the center of activity on the Seine. It has been particularly difficult to get trains from the St. Lazare Station, which lies in the northwestern part of Paris, to the Champ de Mars. A wide detour of 25 kilometers had to be made around the western end of the city, whereas the air-line distance between the two stations is only 4 kilometers. A convenient connection has now been made by converting the Belt Line between St. Lazare and the Trocadero Station into a four-track road, and having two tracks branch off from the latter point and proceed by tunnel and open cut under the Passy section of the city, then across the Seine by a steel bridge, and up the left bank to the Champ de Mars. From there the new line is continued parallel with the river, in open cut and subway, to the Esplanade des Invalides, where there is an extensive underground terminus. Provision is made for a future connection between this station and that on the Quai d'Orsay, only a short distance away.

These changes, however, did not improve the situation at the Montparnasse Station, in the southern part of the city, where there is not only considerable through traffic but also a heavy local business with Versailles, all carried into the city on two tracks. It was found impracticable to make a four-track road here, and even had this been done, passengers would not have landed any nearer the center of the city. So it was decided to build an entirely new line, which branches off from the main road at Viroflay, near Versailles, proceeds through a 4-kilometer tunnel under the Bois de Meudon, and joins the Moulineaux Railway on the left bank of the Seine, near Issy. From here it continues up the river to the Champ de Mars, where it joins the new Trocadero line and runs into the Invalides Station. This new road promises to have its capacity severely taxed, and as it will run for so great a distance through tunnel and subway and will terminate in an underground station, it is to be equipped with a combined electric and compressed-air system. In general, it will be run on the third-rail system, with powerful electric locomotives, but there will also be compressed-air locomotives for switching service at the Invalides Station, for helping out on the particularly heavily travelled section between the Champ de Mars and the Invalides, and for assisting any trains which may possibly get stalled in the Meudon tunnel.

Improvements are also under way at the Eastern and the Lyons Stations. The latter is being completely rebuilt and modernised, and the number of tracks on the Lyons road has been increased to four for a distance of 16 kilometers outside the city, with a purposed future increase of the number to six.

All these changes and improvements have doubtless been hastened by the coming of the Exposition, and though they may not all be finished in time for the rush of travel this summer they will contribute to the lasting benefit of the travelling public at Paris.

REVIEW OF THE AMERICAN PRESS

Electric Driving for Factory Machinery.

It has been said that the unhesitating "scrapping" of superseded machinery, however costly it may have been, is the foundation of success in manufacturing. The principle is largely admitted and consistently acted upon in American shops, but Prof. Wm. S. Aldrich, in an excellent paper presented at the latest meeting of the American Society of Mechanical Engineers and forming part of Volume XXI. of the *Transactions*, calls attention to the fact that though "each year more and more machinery is thrown into the scrap heap to make room for new and improved types, yet antiquated and costly methods of transmitting power are left in service. Modern methods of workship production, in which machine tools are worked up to the power limit, are seen to be sought after side by side with belted transmission of power, which makes it quite impossible to realize fully the value of the new method."

In most new installations, as Professor Aldrich says, electric transmission has received full consideration, but in older plants it has to fight its way against the established usage of shafting, belting, and rope drives. It is not, as he hastens to show, a universal panacea; "there are many factories and mills in which the introduction of electricity for power transmission will not pay"; but there are more in which the investment necessary for the change would be dividend paying. Each case must be considered individually. For certain very definite reciprocating motions hydraulic mechanisms are best suited: "for reciprocating movements requiring a cushioning effect, compressed air is best adapted"; but "for all manufacturing operations requiring rotary motion, continuous or intermittent, uniform or variable, and reversible or otherwise, electric motors provide the readiest facilities."

The main general advantages of the electric-transmission system are thus summed up: Centralization of the mechanical plant, for light, heat, and power: ability to place the plant near to coal and water-supplies; possibility of locating the engine at any convenient distance from the machines, unfettered by length or direction limitations of shafting; and subdivision of the generating plant into duplicate and interchangeable units, each of which can be loaded to the normal capacity, so that the portion of the power plant running may always be kept under practically uniform load. "The introduction of electric transmission has been greatly facilitated by the recent standardization of electrical machinery, and especially that required for power purposes. This, furthermore, facilitates repairs and renewals, if it were necessary to advance this as an argument in favor of electricity. Fortunately, electric machinery as made to-day requires the simplest moving parts and the fewest repairs and renewals."

Passing to the discussion of efficiency, Professor Aldrich points out that the friction loss of all mechanical-transmission systems being practically constant, the efficiency of such a system falls off rapidly below full load. He gives curves of variation of efficiency of a 275 horse-power engine, having a mechanical efficiency of 90 per cent. at full load, operating heavy machinery. The friction losses are plotted from actual values as given by Prof. C. H. Benjamin, in a paper recently presented to the Society. The resultant is that while with "100 per cent. load there is 45 per cent. available for useful work, at three-quarters load there is only 28 per cent. available for work and at 55 per cent. of the full load there is nothing left for work, all power being consumed in overcoming the combined friction of the engine and the transmission machinery."

Against this, electric motors are characterized by high maintained efficiencies at part load. Curves are given showing the

combined or "plant-efficiency" of engine and dynamo supplying power for electric motors of different sizes. Taking the extreme case of twenty 10 horse-power motors (requiring a steam-generating plant of 275 indicated horse power), at full load 63 per cent. of the engine power is available for work; at three-quarters load, 62 per cent.; at half load, 51 per cent.; and not until we drop to something less than one-quarter load is the entire power consumed in engine, dynamo, and motor losses. The performance of the mechanical plant declines very rapidly below full load; the best performance of the electrical system may be maintained all the way from three-quarter load to 25 per cent. overload.

In the matter of distribution, a composite system may be best, even for so short distances. Direct or alternating current, and simple, two-, three-, or four-wire systems are all adapted to different requirements. Preferably all distribution should be direct, avoiding storage batteries, rotary converters, and transformers, except for special lines of work. A wide range of voltages is possible, but Professor Aldrich deprecates the use of a higher voltage than 550.

With direct-current motors, resistances made the control of torque and speed simple, but at the useless expenditure of energy. The Ward-Leonard system, with its two additional machines, came to the rescue and has been successfully and extensively used in elevators, cranes, etc. "The difficulties with commutators have been almost entirely overcome," and "such objectionable features as remain * * * are inherent in the direct-current system used, and are found to lie chiefly in the kind of armature, commutator, and brush devices required. Rough usage, dirt, and the difficulty of expert care and daily inspection have hindered the electric motor from making a better record in its early history. The alternating-current system with its induction-motor service is "probably the most perfect yet developed" in factories and mills. The motor "may be started and operated from any point, at any time, at practically any load and speed within its predetermined ranges. It may be used on 110-, 220-, 440-, or 550-volt alternating-current circuits of one, two, or three phases. It does not require any direct-current supply as the synchronous motor does for its field excitation. It does not require any brushes, commutators, or collecting rings." Offsetting this are the large generating-power-plant required, the slight falling off of speed as the load is increased, and the sacrifice of some efficiency on starting under heavy load and also upon speed changes during operation. By suitable arrangement of field windings, the speed may readily be altered in regular steps. In ordinary shop usage, the "slip" is not objectionable, and the great advantage is the ability of the motors to stand heavy overloads and the impossibility of burning them out.

"Synchronous motors are admirably adapted to factory service where absolute uniformity of speed is required, and where the extra installation of a direct-current supply for their field excitation is not deemed objectionable." They may be overloaded to at least three times the normal load without falling out of step. Where the motors are designed, installed, and operated under the best conditions the power plant need not be larger than that for direct-current working.

The "ideal conditions in a factory installation," Professor Aldrich finds in the use of both induction and synchronous motors —"the former for small machines and direct driving, the latter for operating a set or group of machines. The synchronous motors would be started up just before beginning the work of the day, have at all times a light constant load, and might easily be so regulated as to produce an almost balanced system in combination with the induction motors. * * * The whole system would be operated practically throughout quite a range of load variations, as if it were a simple direct-current system. The advantage of such a system is apparent; it means least installation for any given output, or greatest output for any given capacity of generating plant. The group method of driving is much better adapted for small machines up to and including 2 horse-power capacity, and especially where such machines are in almost constant service. Above this size, individual motor driving becomes more and more efficient, particularly if the machines are operated only a fraction of the day."

Cape Nome.

CAPE NOME, the newest gold-producing wonder of the Pacific United States, is attracting livelier attention as the opening of its second season draws near. The production of the first summer—1899—is said to have exceeded $2,400,000 and a much larger output is expected in 1900. Relatively to its age, the district is comparatively well studied, and a very good idea of the occurrence and origin of the gold is given by Messrs. F. C. Schrader and Alfred H. Brooks, in the *Transactions of the American Institute of Mining Engineers,* while an article by Mr. Charles G. Yale, statistician of the United States Mint, San Francisco, in the *Scientific American Supplement,* gives a shorter account of the Nome deposits, contrasting them with the gold sands of the California beaches and presenting some details of the methods of working, which so far have been decidedly crude.

There has been manifest lately a strong disposition to believe that the entire sea floor of Bering Straits and the ocean south of them is auriferous, and current newspaper stories give a circumstantial account of a "syndicate" which has secured "concessions" for the entire northeastern Siberian coast, from which untold wealth is to be extracted. All three of the writers just mentioned, however, refer the source of the gold to the mineralized veins and country rock back from the coast on the American side. Messrs. Schrader and Brooks say they "wish to emphasize this, because of the popular idea that the Nome placer gold has been brought from great distances by the action of the ice, or through some convenient convulsion of nature." Mr. Yale feels no doubt of the agency of glacial action, but it is that of the glaciers coming down from the hills behind, whose "terminus * * * was the ocean, where they became disintegrated and gave up their burdens of stone, gravel, gold, etc." This idea is supported by the fact that the gold "is more or less angular and does not seem to have been much waterworn, as in ordinary placers"; "many pieces are found with the quartz still clinging to them"—a fact mentioned also by Messrs. Schrader and Brooks: "on the Nome tundra, the presence of gold is not confined to the beds of waterways, but it is found all over the district, being, however, concentrated in larger quantity in the creek beds, where moving water has gathered it."

Another writer in the *Scientific American* states that at the breaking up of winter "the ice cakes of the streams invariably bring down loads of gravel which is deposited as they are dissolved by the heats of summer. This theory is responsible for the general belief that the deposits of gold-bearing gravel cover the entire floor of Norton Sound." It is generally agreed that the deposits extend seaward, and many projects for dredging beyond the surf are to be tried, it is said, this summer. The difficulties of deep dredging on an exposed coast are manifest, and the efforts so far made in this direction have not been encouraging.

Messrs. Schrader and Brooks describe the Nome region proper as an ill-defined area in about the center of the southern margin of the Seward peninsula, about 100 miles southeast of Bering Straits. Here a crescent-shaped, moss-covered plain stretches inland from the coast, having an extreme width of 4 or 5 miles. Cape Nome forms its eastern and West Point its western apex. To the north this plain is broken into a succession of ridges, the highest one of which merges with the rounded slopes of the mountains. The drainage of the region is taken to the Bering Sea by several streams of considerable size, which have broad valleys with gently rising slopes. * * * A striking feature of the topography is a series of benches and terraces which occur in the plain and on the mountain slopes."

"From the standpoint of the gold-seeker the most interesting formations of the regions are the gravels. These are found forming stream terraces along the creeks and marine terraces in the tundra, and on the mountain slopes. Their presence indicates a gradual elevation of the entire area. The pebbles of the gravel, as far as we have observed, can usually be traced to some local source."

These authors group the placer deposits as gulch placers, bar placers, beach placers, tundra placers, and bench placers. Only the gulch and beach deposits have produced largely as yet. The gulch placers, con-

sisting of the "flood plain or gravel deposits of the streams," vary from twenty to several hundred feet in width; the gold is not evenly distributed through them, nor is the pay-streak (which is usually on or near to bed-rock, under 5 to 8 feet of gravel) continuous; detached pockets are sometimes very rich. The gold is "usually rounded, and often smoothly polished"; the nuggets are round and sub-angular, seldom flat, and vary from the size of a pin-head to 25 ounces, many of them being "about the size of a No. 3 shot, while nuggets from ½ ounce to 1 ounce are not uncommon."

The beach placers, in which the gold is much finer, ranging in size from a pin head to flour gold, are largely "a concentration of the gold carried by the gravels and sands of the tundra," under the cutting influence of the waves. The gravels and sands are carried away by the undertow, while the heavier gold sinks downward in the sand near the water line. Messrs. Schrader and Brooks suggest that, as similar action has undoubtedly taken place at other stages of a constant elevation, rich ancient beaches may be found in the tundra, which must not, however, be expected generally to show any such richness as is found in the beach.

Bench placers have not yet been worked to any extent, chiefly on account of the difficulty of getting water. Nor have the bar placers been largely developed, although it was on the bars of Snake River that gold was first discovered at Nome.

The open season extends from June to November, and communication is kept up during the winter by dog and reindeer sleds. There is no harbor, and landing must be made by barges. The absence of timber is a serious drawback, and will be felt more severely when the present supply of driftwood is exhausted. Lumber and coal have been extremely dear, through the failure of dealers to appreciate the markets afforded; but the comparative accessibility of the region will no doubt lead to an enormous influx during the summer of 1900.

The Coal Fields of Shansi, China.

It does not require a very severe nor a very long-lasting coal famine to advance the question of the exhaustion of fuel supply from a purely academic discussion to one of pressing economic importance. The present situation in Great Britain brings the matter near enough home to lend a heightened interest to the description of the coal-fields around Tsê Chou, Shansi, China, by Mr. Noah Fields Drake, which was presented at the last meeting of the American Institute of Mining Engineers and is printed in their *Transactions*.

The district was first adequately examined by Baron von Richtofen, in 1870, but the anti-foreign attitude of the Chinese government has since prevented development, until now its exploitation by the Peking syndicate seems to be at hand, this English-Italian company having concessions to work the coal of the Tsê Chou region as well as of the Shansi fields.

The Tsê Chou coal area examined by Mr. Drake lies about 300 miles southwest of Tientsin and about 500 miles northwest by west from Shanghai, and shows a "mingling of ridges, hills, narrow elevated valleys and rough rolling lands." The rock beds lie comparatively level, with some conspicuous folding and faulting giving narrow belts of eastward-dipping strata and long west-northwest dipping areas in which the dips are rarely greater than 7° or 8°, and "the average dip of the whole earth-crust block is probably not more than 1° or 2°; 22 to 23 feet is given as the probable average thickness of the main workable Tsê Chou coal bed, though Mr. Drake had no opportunity to measure its full thickness nor to examine it except where it is being mined. At one mine, near Hsi Ta-yang, only the lower 10 or 12 feet is being taken out through a shaft 329 feet deep. Mr. Drake was told by Chinese miners that the full thickness of the bed is 30 feet Chinese, equal to 36 feet English. Parting streaks of shaly coal are common, but no waste coal is taken out, and the average ash is probably not higher than 10 per cent. In two mines a couple of miles northeast of Tsê Chou Mr. Drake saw coal-beds from 17 to 23 feet thick, the latter being made up quite uniformly of a lower stratum of 3 feet of earthy friable coal, 14 feet of hard, firm, evenly good coal, 1 inch of carbonaceous shale, and 6 feet more of good coal. In a mine 1½ miles west of Ta-chi, where the Chinese miners said the bed has a thickness of 23½ feet, Mr. Drake saw the upper 15 feet only.

The coal "is wonderfully bright and glossy throughout. It breaks with a conchoidal fracture, and is so free from dust that it can often be handled without soiling the hands."

The area mapped by Mr. Drake, about 150 square miles, contains about 3,000,000,000 metric tons, supposing 22 feet to be the average thickness of the bed and 1.5 the average specific gravity. And "it must be remembered that this area is only a little of the ragged edge of the great coal-fields of Shansi. * * * Richtofen estimates that the anthracite coal alone of Shansi amounts to 630,000,000,000 tons, and that the coal area of Shansi is greater than that of Pennsylvania."

The Tsê Chou coal is all anthracite, hard enough to support any weight in the blast furnace, uniformly low in sulphur and comparatively low in ash.

The limitations to Chinese engineering ability, which Mr. Parsons epigrammatically defines on another page of this magazine, are strikingly apparent in the methods of Tsê Chou. The coal is dug, hoisted, and transported without explosives or power applications. Mining is done with pick and gad; the coal is raised by a man-power windlass, which in the larger mines may have a circumference of five feet; a crank at each end, with a long arm, allows four or five men to work at turning it. About 300 pounds of coal are hoisted at a time, in baskets. From the foot of the shaft, tunnels are run through the coal-bed, and at intervals large quantities of coal are taken out, leaving rooms about 40 to 50 feet in diameter. Very little coal is taken out through inclines, and none through tunnels, though in some cases a horizontal tunnel as long as the vertical shaft would cut the coal.

The output is about 50,000 tons per annum from the Tsê Chou area, and it is carried to its market, locally or on the plains 20 miles away, in little carts drawn by oxen or, far more largely, by pack animals—mules, donkeys, and men. The trails are "from 12 to 14 feet wide and paved with stone. By ages of use, these stones have been worn until their tops are smooth and spherical in shape. Over these rough and steep trails there is, during fair weather, an almost continuous line of pack animals passing to and fro, and most of these are employed in carrying coal."

Mr. Drake points out the striking contrast between present conditions and the possibilities under modern methods. Richtofen has suggested that the horizontal beds would allow long railroad tunnels to be run directly into the beds, within which cars could be loaded for distant transport. The completion of some of the projected railways will doubtless bring an enormous development of the region.

Proposed Standard Specifications for Steel.

THE progress of the International Association for Testing Materials has been frequently noted in these pages, and it is most gratifying to friends of the movement, as it must be especially to the American Branch of Committee No. 1, to find how appreciative a reception is given to the fruits of their work, just distributed. These take the form of ten bulletins, each devoted to the specifications for one class of material as adopted for recommendation by the American Section of the Association, the list being as follows: No. 8, Structural Steel for Bridges and Ships; No. 9, Structural Steel for Buildings; No. 10, Open Hearth Boiler Plate and Rivet Steel; No. 11, Steel Rails; No. 12, Steel Splice Bars; No. 13, Steel Axles; No. 14, Steel Tires; No. 15, Steel Forgings; No. 16, Steel Castings; No. 17, Wrought Iron. Extended notice of the bulletins and the Committee report accompanying them is given by the *Engineering Record*, *Iron Age*, and *Railroad Gazette*.

The *Gazette* presents what it calls "three tables, giving synopses of the proposed specifications," which, however, are in reality tabular statements of the many individual specifications of leading engineers, manufacturers, and railroad companies forming the basis of the proposed standard specifications put forth by the Committee. The *Iron Age* gives a comparative and discriminating review of the nine specifications for steel, tracing the various requirements specified throughout the entire list. The *Record* gives the substance of three of the bulletins, with an excellent editorial commending the labors and wisdom of the International Association and expressing the general conclusion that "the proposed specifications * * * represent,

at least fairly well, features of good practice." It calls attention, however, to the fact that: "In the specifications for bridges, buildings, and ships, there is found no reference to high steel, *i. e.*, steel running in ultimate resistance from 70,000 to 78,000 pounds per square inch. It is true that much of such material is not used, but some is, and more is likely to be * * * in bridges and buildings it is well adapted to column designs, and it is likely to become more so. There seems to be no reason why such steel should not be recognized, and it would be a matter of no surprise if discussion should justify that observation. Similarly it would seem only reasonable to give structural steel for buildings the same range in classes of material as that for bridges."

A broader point, perhaps, is made in the concluding criticism that "The ductility of the material is in all cases measured by the elongation only. * * * It should be carefully considered whether that is not a mistake. The reduction of area is in many cases a most valuable indication of ductility, and in all ordinary testing it is a feature which practice enables to be measured with ease. Its omission is a serious matter and may not be justified." It is our impression, however, that the association acted advisedly in omitting the reduction-of-area specification, and will be able to support its position ably.

The whole work so far can not be considered—and is not considered by the association—as more than "the beginnings of a set of standard specifications." The story of its growth, however, awakens the utmost admiration for the painstaking manner in which the committee has proceeded. The material was first subdivided into classes, as indicated by the bulletins, the preparation of specifications for each class being confided to a separate sub-committee. A circular letter was then sent to the leading engineers, railroad companies, and manufacturers of the United States, requesting copies of their specifications, as a composite basis from which to start. Next followed the preparation and circulation of series of questions, drawing out further information, the compilation of reports, and the discussion of each specification in detail, item by item. After half a dozen meetings, the rough drafts were sent to all members of Committee No. 1, and after renewed discussion in the light of their general comment, the specifications were edited in the same general form and the tabular summaries of the specifications in general use (by which the bulletins are accompanied), were prepared. Each specification was then discussed again in detail, some minor changes were made, and all were printed for distribution as they now appear. The national engineering societies have been asked to take them up for discussion, and the entire American Section of the International Association, together with the leading engineers of the country, are invited to submit their criticisms at the autumn meeting of the association next October.

The chairman and secretary, Mr. Wm. R. Webster and Dr. Wm. H. Wahl, present their report with the modest conclusion: "What we really want to know is, are these fair representatives of specifications in use in this country, and the best American practice? If not, then what modifications are required to make them so?" Their labor should meet with the strongest encouragement, for national agreement is the first step toward the international agreement upon specifications and methods of testing which is most important in the growing expansion of international engineering trade.

Minerals of the Philippines.

Mr. George F. Becker, in *Scribner's*, touches briefly upon the mineral wealth of the Philippines, which was reviewed at length in these pages by Dr. David T. Day, chief of the division of statistics, U. S. Geological Survey, in May, 1899. While closely confirmatory of Mr. Day's summary, Mr. Becker throws additional light upon the gold resources of the islands, which on further study seem to diminish in importance. The natives are extremely skilful with the pan, he says, and "also understand 'salting' a mine."

They have been working the gravels for centuries, and even going into the quartz, and have probably left few prizes. Mr. Becker considers the "gold resources of the Philippines comparable with those of the Carolinas and Georgia, rather than with those of Colorado or California."

THE ENGINEERING INDEX

"THE KEYSTONE IN THE ARCH OF APPLIED SCIENCES IS THE ENGINEERING INDEX"

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THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED.

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the Index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *qr*, a quarterly, *s-q* semi-quarterly, etc. Other abbreviations used in the Index are: Ill—Illustrated; W—Words; Anon—Anonymous.

American Architect. *w.* Boston, U. S. A.
American Electrician. *m.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Gas Light Journal. *w.* New York.
American Geologist. *m.* Minneapolis, U. S. A.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Am. Manufacturer and Iron World. *w.* Pittsburg, U. S. A.
American Shipbuilder. *w.* New York.
Annales des Ponts et Chaussées. *m.* Paris.
Architect. *w.* London.
Architectural Record. *q.* New York.
Architectural Review. *s-q.* Boston, U. S. A.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Sydney.
Automobile Magazine. *m.* New York.
Automotor & Horseless Vehicle Jl. *m.* London.
Brick Builder. *m.* Boston, U. S. A.
British Architect. *w.* London.
Brit. Columbia Mining Rec. *m.* Victoria, B. C.
Builder. *w.* London.
Bulletin Am. Iron and Steel Asso. *w.* Philadelphia, U. S. A.
Bulletin de la Société d'Encouragement. *m.* Par's.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
California Architect. *m.* San Francisco, U. S. A.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. m. Montreal.

Canadian Mining Review. *m.* Ottawa.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.
Comptes Rendus de l'Acad. des Sciences. *w.* Paris.
Consular Reports. *m.* Washington.
Contemporary Review. *m.* London.
Deutsche Bauzeitung. *b-w.* Berlin.
Domestic Engineering. *m.* Chicago.
Eclairage Electrique. *w.* Paris.
Electrical Engineer. *w.* London.
Electrical Review. *w.* London.
Electrical Review. *w.* New York.
Electrical World and Engineer. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Electricity. *w.* London.
Electricity. *w.* New York.
Elektrizität. *b-w.* Leipzig.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnische Zeitschrift. *w.* Berlin.
Elettricita. *w.* Milan.
Engineer. *w.* London.
Engineer. *s-m.* Cleveland, U. S. A.
Engineers' Gazette. *m.* London.
Engineering. *w.* London.
Engineering and Mining Journal. *w.* New York.
Engineering Magazine. *m.* New York & London.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penn'a. *m.* Pittsburg, U. S. A.
Fire and Water. *w.* New York.
Foundry. *m.* Detroit.
Gas Engineers' Mag. *m.* Birmingham.
Gas World. *w.* London.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Giorn. Dei Lav. Pubb. e d. Str. Ferr. *w.* Rome.
Glaser's Ann. f. Gewerbe & Bauwesen. *s-m.* Berlin.
Heating and Ventilating. *m.* New York.
Horseless Age. *m.* New York.
Ice and Refrigeration. *m.* New York.
Indian and Eastern Engineer. *m.* Calcutta.
Industries and Iron. *w.* London.
Inland Architect. *m.* Chicago.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron & Steel Trades Journal. *w.* London.
Iron Trade Review. *w.* Cleveland.
Journal Assn. Eng. Socities. *m.* Philadelphia, U. S. A.
Journal of Electricity. *m.* San Francisco.
Journal Franklin Institute. *m.* Philadelphia.
Journal of Gas Lighting. *w.* London.
Journal Royal Inst. of Brit. Arch. *s-qr.* London.
Journal of Sanitary Institute. *qr.* London.
Journal of the Society of Arts. *w.* London.
Journal of U. S. Artillery. *b-m.* Fort Monroe, U. S. A.
Journal Western Soc. of Eng. *b-m.* Chicago,
Journal of Worcester Poly. Inst., Worcester, Mass.
L'Energie Electrique. *w.* Paris.
Locomotive. *m.* Hartford, U. S. A.
Locomotive Engineering. *m.* New York.
Machinery. *m.* London.
Machinery. *m.* New York.
Marine Engineer. *m.* London.
Marine Engineering. *m.* New York.
Marine Review. *w.* Cleveland, U. S. A.
Master Steam Fitter. *m.* Chicago.
Mechanical Engineer. *w.* Manchester.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metal Worker. *w.* New York.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco, U. S. A.
Mining Reporter. *w.* Denver, U. S. A.
Mitt. aus d Kgl. Tech. Versuchsanst. Berlin.
Mittheilungen des Vereines für die Förderung des Local und Strassenbahnwesens. *m.* Vienna.
Modern Machinery. *m.* Chicago.
Moniteur des Architects. *m.* Paris.
Moniteur Industriel. *w.* Paris.
Municipal Engineering. *m.* Indianapolis, U. S. A.
National Builder. *m.* Chicago.
Nature. *w.* London.
Nature. *w.* Paris.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Nineteenth Century. *m.* London.
Oest. Monatsschr. f. d. Oeff. Baudienst. *m.* Vienna.
Oest. Zeitschr. f. Berg- & Hüttenwesen. *w.* Vienna.
Ores and Metals. *w.* Denver, U. S. A.
Plumber and Decorator. *m.* London.
Popular Science Monthly. *m.* New York.
Power. *m.* New York.
Practical Engineer. *w.* London.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Proceedings Engineers' Club. *qr.* Philadelphia, U. S. A.
Proceedings St. Louis R'way Club, *m.* St. Louis, U. S. A.
Progressive Age. *s-m.* New York.
Railroad Car Journal. *m.* New York.
Railroad Gazette. *w.* New York.
Railway Age. *w.* Chicago.
Railway & Engineering Review. *w.* Chicago.
Review of Reviews. *m.* London & New York.
Revue de Mécanique. *m.* Paris.
Revue Gen. des Chemins de Fer. *m.* Paris.
Revue Technique. *b-m.* Paris.
Revue Universelle des Mines. *m.* Liége.
Rivista Marittima. *m.* Rome.
Sanitary Plumber. *s-m.* New York.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Stahl und Eisen. *s-m.* Düsseldorf.
Stevens' Institute Indicator. *qr.* Hoboken, U. S. A.
Stone. *m.* New York.
Street Railway Journal. *m.* New York.
Street Railway Review. *m.* Chicago.
Telephone Magazine. *m.* Chicago.
Tramway & Railway World. *m.* London.
Trans. Am. Ins. Electrical Eng. *m.* New York.
Trans. Am. Ins. of Mining Eng. New York.
Trans. Am. Soc. of Civil Eng. *m.* New York.
Trans. Am. Soc. of Heat & Ven. Eng. New York.
Trans. Am. Soc. Mech. Engineers. New York.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Transport. *w.* London.
Western Electrician. *w.* Chicago.
Wiener Bauindustrie Zeitung. *w.* Vienna
Yacht. *w.* Paris.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschrift für Elektrochemie. *s-m.* Halle a. S.
Zeitschrift für Elektrotechnik. *s-m.* Halle a. S.

ARCHITECTURAL ENGINEERING

CONSTRUCTION.

See also Civil Engineering, Materials.

Arch.

See Roof Arches, below.

See also Arch and Masonry Arch, under Civil Engineering, Construction.

Church.

A Concrete Church. Illustrated description of a monolithic concrete church built by a wealthy congregation in Brooklyn, N. Y. 1000 w. Eng Rec—May 5, 1900. No. 33999.

Fireproof.

Fireproof Construction. Editorial, reviewing a recent work by J. K. Freitag—"The Fireproofing of Steel Buildings." 4000 w. Builder—April 28, 1900. No. 34049 A.

The Second Fire in the Horne Department Store at Pittsburg. Peter B. Wight. Describes the construction of the building after the first fire, and illustrates the damage, calling attention to the lessons of the second test. 2800 w. Br Build—May, 1900. No. 34419 C.

Foundations.

Foundations for Kingsbridge Power Station for the Third Avenue Railway, New York City. Illustrated description of a construction consisting of a concrete cap carried by piles. 800 w. Eng News—May 17, 1900. No. 34309.

Hippodrome.

The New Hippodrome at Paris (Le Nouvel Hippodrome). G. Leugny. A well-illustrated account of the construction of this building, particularly of the roof trusses. 1800 w. Revue Technique—April 25, 1900. No. 34478 D.

Hospitals.

The Requirements of Modern Hospitals (Ueber Bedürfnisse Moderner Krankenanstalten). Franz Berger. A general discussion of hospital construction and sanitation, with plans. 7000 w. Zeitschr d Oest Ing u Arch Ver—May 11, 1900. No. 34143 B.

Lightning Protection.

See Electrical Engineering, Miscellany.

Metal Protection.

The Theory and Practice of Protective Coatings for Structural Metal. A. H. Sabin. Describes experimental tests made on metal plates, the general effect of different paints, the way the paints are produced, composition of varnishes, etc. Discussion. 8000 w. Pro of Engs' Club of Phila—May, 1900. No. 34298 D.

Zinc a Protective Coating for Iron and Steel. Sherard Cowper-Coles. Abstract of paper read at meeting of Cleveland Inst. of Engs., England. Claims it is cheaper and more effective than painting, and describes the processes. Discussion. 2800 w. Col Guard—April 27, 1900. No. 34069 A.

Office Building.

The New Edison Building in Chicago. Describes and illustrates this fine building and its contents. 5400 w. W Elect'n—May 19, 1900. No. 34425.

The United Gas Improvement Company Office Building. Illustrated description of a fine building in Philadelphia, devoted entirely to the gas business. 1700 w. Pro Age—May 15, 1900. No. 34291.

Roof Arches.

The Newark Armory Drill Hall. Illustrated description of a drill-hall, having 163½ ft. 3-hinge roof arches containing several special features. The erection of the roof is also described. 1200 w. Eng Rec—May 26, 1900. No. 34435.

School.

Primary School House in Zurich (Das Primarschulhaus au der Klingenstrasse in Zürich—Kreis III.). A. Geiser. A short description, with illustration and plans. 500 w. Schweiz Bauzeitung—April 28, 1900. No. 34163 B.

Terra-Cotta.

The Manufacture of Terra-Cotta and Its Use as a Building Material. H. A. Webber. Follows the work through the factory, step by step, discussing its durability, cost, etc. 5500 w. Tech., No. 14—1899-1900. No. 34387 D.

HEATING AND VENTILATION.

Court-House.

Ventilation and Heating, Appellate Court House, New York. Illustrated description of a dual plant, one for operation during the hours when many parts of the building are liable to be crowded, and the other for the period from 5 P. M. to 6 A. M. 2700 w. Eng Rec—May 12, 1900. No. 34282.

Hospital.

Ventilating and Heating the City Hospital, Albany. Illustrated account of the special features of a large one-pipe system of heating by direct-indirect radiation, with a natural system of ventilation.

1800 w. Eng Rec—May 26, 1900. No. 34436.

Hot-Water Heating.

Hot-Water Heating from a Central Station. H. T. Yaryan. Illustrated description of the system of the Toledo Heating and Lighting Co. 3300 w. Trans Am Soc of Mech Engs, No. 852—May, 1900. No. 34093 C.

Mills.

Warming and Ventilation of Mills. A summary of the advice given by S. Horner Woodbridge for work of this sort. 2600 w. Eng Rec—May 5, 1900. No. 34001.

Steam Heating.

The Removal of Condensation Water in Low Pressure Steam Heaters (Die Kondenswasserableitung bei Niederdruck-Dampfheizungen). An illustrated general account, with particular description of the Poensgen apparatus. 800 w. Gesundh Ingenieur—April 30, 1900. No. 34160 B.

Warming.

Warming and Ventilation. T. Wilson Aldwinckle. Read before the London Arch't Assn. Discusses this subject in general, also mechanical and natural ventilation, and special ventilation and warming as applied to various classes of buildings. 5000 w. Builder—April 21, 1900. No. 33906 A.

PLUMBING AND GAS FITTING.

Swimming Bath.

The Wissahickon Heights Swimming Pool. Illustrated description of an 81 x 30-ft. pool used for summer bathing, built in a superior residence portion of Philadelphia. 1000 w. Eng Rec—May 26, 1900. No. 34434.

MISCELLANY.

Acoustics.

Architectural Acoustics — Reverberation; Rate of Decay of Residual Sound. Wallace C. Sabine. Illustrated explanation of the theory of the manner in which residual sounds die out in auditoriums, and its confirmation by experiments. 2500 w. Eng Rec—May 5, 1900. No. 34000.

Architectural Acoustics — Reverberation; Exact Solution. Wallace C. Sabine. A discussion of the physical principles which underlie the annoying reverberation in some rooms. 2500 w. Eng Rec—May 12, 1900. No. 34283.

Architectural Acoustics — Reverberation; the Absorbing Power of an Audience, and Other Data. Wallace C. Sabine. Gives the results of experiments to determine the effect of people and inanimate objects to prevent annoying reverberations in an auditorium, in terms of a sq. m. of open window surface. 3100 w. Eng Rec—May 19, 1900. No. 34337.

Architectural Acoustics — Reverberation; Calculation in Advance of Construction. Wallace C. Sabine. Illustrated description of the methods adopted in preparing plans for a large concert hall to avoid annoyance from reverberation. 2200 w. Eng Rec—May 26, 1900. No. 34437.

Laboratory.

The Physical-Chemical Laboratory of Giessen University (Das Physikalisch-Chemische Laboratorium der Grossherzoglich Hessischen Landes-Universität Giessen). Prof. K. Elbs. A description, with plans, of this new laboratory. 1800 w. Zeitschr f Elektrochemie—April 26, 1900. No. 34168 G.

Paris Exposition.

The Paris Exposition of 1900. C. L. Durand. An account of the opening ceremonies and a sketch of the main features of the electrical and mechanical sections. Ill. 8500 w. Elec Rev, N. Y.—May 2, 1900. No. 33966.

CIVIL ENGINEERING

BRIDGES.

Accident.

Accident to the Van Buren Street Bridge, Chicago. Description of an accident to the Scherzer bascule bridge over the Chicago River. The accident is supposed to have been caused by a defective casting. 800 w. Eng News—May 10, 1900. No. 34232.

Collapse of the Foot Bridge Leading to the "Celestial Globe" at the Paris Exposition (Effrondrement de la Passerelle du "Globe Céleste"). A short general description of the bridge, with plans; and photographs taken after the accident. 500 w. Génie Civil—May 5, 1900. No. 34185 D.

The Bridge Collapse in Paris. Comment on the collapse of the foot-bridge at the Paris Exhibition, and the strength of armored concrete. 1400 w. Engr, Lond. May 4, 1900. No. 34259 A.

Arch.

The Hingeless Arch. Discusses the

subject of stresses, including those due to changes of temperature. 1800 w. Engr, Lond—April 27, 1900. No. 34071 A.

The 3,820-ft. Stone Arch Bridge for the Pennsylvania R. R. at Rockville, Pa. Illustrated description of the general details of the longest stone arch railway bridge in the world. 700 w. Eng News—May 10, 1900. No. 34230.

See also Roof Arches, under Architecture, and Building, Construction.

See also Masonry Arch, under Civil Engineering, Construction.

Chain Bridge.

The Manufacture of the Chain Links for the Schwurplatz Bridge Over the Danube at Buda-Pesth (Die Herstellung der Kettenglieder für die Schwurplatz-Brücke über die Danau bei Budapest). Julius Seefehlner. An illustrated general account of this chain highway bridge, with details of the manufacture of the links. Serial. 1st part. 2700 w. Zeitschr d Ver Deutscher Ing—May 5, 1900. No. 34107 D.

Concrete-Steel.

Concrete-Steel Construction in the Proposed Memorial Bridge. Illustrated description of the design of a 192-ft. arch, with practically all the tensile stresses taken by steel members hidden by concrete and cut-stone masonry. 1000 w. Eng Rec—May 26, 1900. No. 34429.

Iron Concrete Foot-Bridge at the Paris Exposition (Passerelle en Béton Armé Reliant le Pavillon de Madagascar au Trocadéro). Ch. Dautin. A short illustrated description of this bridge, constructed on the Hennebique system. 400 w. Génie Civil—May 12, 1900. No. 34189 D.

Design.

Artistic Design for a Movable Bridge. An illustration of the possibilities of artistic and monumental design for this type. 600 w. Ry & Engng Rev—May 12, 1900. No. 34290.

Drawbridge.

Eight-Track Rolling-Lift Drawbridge Over the Chicago Drainage Canal. Illustrated description of the accepted design, with statement of the unusually complicated conditions. 1600 w. Eng News—May 24, 1900. No. 34411.

The Eight-Track Scherzer Rolling Lift Bridge at Chicago. Illustrated description of an 8-track span of 150 ft. on a 68-degree skew, designed as a fixed span for early service and subsequent modification into a bascule bridge, when the waterway below is open for boats. 1900 w. Eng Rec—May 26, 1900. No. 34430.

East River Bridge.

Erection of Towers of New East River Bridge. Illustrated description of the various methods employed in assembling the parts of these skeleton towers, which rise nearly 335 ft. above high water. 2900 w. Eng Rec—May 5, 1900. No. 33993.

The New East River Bridge Approaches. Illustrated description of the viaducts for the pedestrians, surface and elevated cars, carriages and bicyclists on the second suspension bridge between Manhattan and Brooklyn. 2500 w. Eng Rec—May 12, 1900. No. 34281.

The Third East River Bridge. Illustrated description of the plans for the third suspension bridge to be built between Manhattan and Brooklyn, New York. 700 w. Eng Rec—May 12, 1900. No. 34278.

Viaduct Approaches for the New East River Bridge at New York City. Illustrated description of typical structural details. 3000 w. Eng News—May 10, 1900. No. 34226.

Erection.

Some Recent Work of the Keystone Bridge Co., Near Pittsburg. Illustrates and describes the interesting engineering features and methods of construction. 2700 w. R R Gaz—May 18, 1900. No. 34347.

Germany.

German Bridge Building in the 19th Century (Der Deutsche Brückenbau im XIX. Jahrhundert). Prof. Georg Mehrtens. The first part of a very well illustrated history of iron and steel bridge construction, in theory and practice, written on the occasion of the German bridge exhibit at Paris. Serial. 1st part. 7000 w. Zeitschr d Ver Deutscher Ing—April 21, 1900. No. 34103 D.

Moving.

Moving a Bridge. From *La Nature*. Illustrations and particulars of a difficult piece of engineering work. 500 w. Sci Am Sup—May 26, 1900. No. 34407.

Railway Bridges.

The Great Northern Railway—Bridges Over the River Aire. Illustrated detailed description. 1800 w. Engr, Lond—April 20, 1900. No. 33919 A.

Rigid Suspension Bridge.

New Type of a Rigid Suspension Bridge (Nouveau Type de Pont Suspendu Rigide). Com. Gisclard. A general description, with diagrams, of a suspension bridge stiffened by two trusses hinged at the centre. 3500 w. Génie Civil—May 5, 1900. No. 34184 D.

Swing Bridge.

Rebuilding of the Kinnickinnic River Swing Bridge on the Chicago & Northwestern Railway, at Milwaukee, Wis. Frances H. Bainbridge. Illustrated detailed description of the work, with discussion. 6000 w. Jour W Soc of Engs—April, 1900. No. 33923 D.

Sydney Harbor.

Proposed Bridge at Sydney. A copy of terms and conditions for the construction of a bridge connecting Sydney with North Sydney. 1100 w. U. S. Cons Repts, No. 726—May 10, 1900. No. 34089 D.

Thomas Steel.

Report of Bridge Material Committee of the *Oesterr. Ingenieur und Architekten Verein*, on the Admissibility of the Use of Thomas Steel in Bridge Construction (Bericht des Eisenbrücken-Material-Ausschusses über die Zulässigkeit der Verwendung des Thomasflusseisens zu Brückenconstructionen). The full report, illustrated, recommending the use of Thomas steel when certain conditions are fulfilled. 20000 w. Zeitschr d Oest Ing u Arch Ver—April 27, 1900. No. 34141 B.

Discussion on the Report of the Bridge Material Committee of the *Oesterr. Ingenieur und Architekten Verein* (Zur Debatte über den Bericht des Eisenbrücken-material-Asschusses). Franz Kupelweiser A contribution to the discussion on the report mentioned above. 3000 w. Zeitschr d Oest Ing u Arch Verein—April 13, 1900. No. 34137 B.

Viaducts.

Bifurcated Viaduct Approaches in Nashville, Tenn. Illustrated description of the plan of construction adopted. 1000 w. Ry & Engng Rev—May 26, 1900. No. 34444.

The Piney Branch Viaduct, Washington, D. C. Thomas C. J. Baily. Illustrated description of the main features. 1000 w. Eng News—May 17, 1900. No. 34317.

Vienna.

The New Franzens Bridge Over the Danube Canal in Vienna (Die Neue Franzensbrücke über den Danaucanal in Wien). Franz Pfeuffer. A very fully illustrated description of this ornamental highway bridge and its construction. 3 plates. 6000 w. Zeitschr d Oest Ing u Arch Ver—May 4, 1900. No. 34142 B.

CONSTRUCTION.

Arches.

Concrete Arches. Daniel B. Luten. An account of further experiments by the writer upon small model arches of neat Portland cement, bringing out points of interest in design. 3000 w. R R Gaz—May 11, 1900. Serial. 1st part. No. 34238.

See also Masonry Arches, below, and Roof Arches, under Architecture and Building, Construction.

Contracting Methods.

Modern Contracting Methods. Lessons for quarry men from the rock work of the Chicago canal and the New York subway. Gives illustrated description of appliances and methods. 3000 w. Stone—May, 1900. No. 34300 C.

Culverts.

Cement-Concrete Culverts. A. W. Campbell. From a paper read before the Assn. of Ontario Land Surveyors. Concerning the cost, the care needed in mixing and selection of materials, etc. 1500 w. Can Engr—May, 1900. No. 34274.

Docks.

The New South Dock at Cardiff. Illustrated description of work now in progress. 1400 w. Transport—April 27, 1900. No. 34050 A.

Masonry Arch.

The Bear Valley Dam as an Arch. J. M. Alarco. Investigates the only arch dam in the United States, located in San Bernardino Co., California. Ill. 1300 w. Tech, No. 14—1899-1900. No. 34389 D.

The Bourbonnais Railway Arch. C. L. Eddy. A test of the different theories of the masonry arch by applying them to an arch which for years has successfully carried a heavy railroad traffic. 1500 w. Tech, No. 14—1899-1900. No. 34386 D.

Pile-Driving.

On Pile-Driving Machines. F. J. Rowan. A survey of various machines for driving piles, with discussion. Ill. 9000 w. Trans of Inst of Engs & Shipbuilders in Scotland—Feb. and March, 1900. No. 34324 each D.

Roads.

Fallacies in Good-Road Economics. Ira O. Baker. Discusses wagon transportation, and the real advantages of good roads. 5800 w. Tech, No. 14—1899-1900. No. 34381 D.

The Improvement of Our Roads. A. Moresby White. Reviews the Highway Acts of Great Britain; discusses the construction of roads; repairing, and various improvements. General discussion. 8000 w. Jour Soc of Arts—May 11, 1900. No. 34365 A.

Simplon Tunnel.

Simplon Tunnel (Simplon-Tunnel). Abstract of the Jura-Simplon R. R. Co.'s report for the quarter ending March 31, 1900, giving general figures and tables showing the progress of the work in various ways. 1500 w. Schweiz Bauzeitung—May 12, 1900. No. 34166 B.

HYDRAULIC AND WATER SUPPLY.

Contamination.

Algæ as a Cause of the Contamination of Drinking Water. G. T. Moore, in the *Amer. Jour. of Pharmacy*. Information concerning this group of plants, which produces more trouble than any other members of the vegetable kingdom. 3800 w. San—May, 1900. No. 34016 D.

Dam Accidents.

Accident to the Partially Built Dam of the Denver Union Water Co. Views and particulars of the structure and accident. 500 w. Eng News—May 17, 1900. No. 34313.

More Light on the Failure of the Austin Dam. Thomas U. Taylor. Facts explaining some discussed points and discussion of the cause of the break and the possible solutions of the problem of water and lights. 2000 w. Eng News—May 10, 1900. No. 34228.

Some Considerations Regarding the Failure of the Austin Dam. An editorial discussion on the importance of making a perfect jointure between the base of a dam and the bed rock. 1000 w. Eng Rec—May 26, 1900. No. 34427.

The Austin Dam Failure. Letter from C. Baillairge urging the construction of dams and retaining walls of a thickness equal to their height. 1100 w. Eng Rec—May 19, 1900. No. 34338.

The Failure of the Austin Dam. William von Rosenberg, Jr. Illustrated description of the erosion of the river bed at the toe of a 60-ft. masonry dam, subsequently washed away. 900 w. Eng Rec—May 19, 1900. No. 34332.

Dams.

The Reconstruction of Big Hole Dam. Jos. H. Harper. A review showing the weak points in the old structure, the means proposed for strengthening it, features in which the rebuilding differed from the original work, and considerations that influenced the designs and controlled the work. Discussion. Ill. 6500 w. Jour Assn of Engng Socs—April, 1900. No. 34408 C.

Building an Impounding Dam for Storage Reservoir for the Consolidated Gold Fields, Johannesburg, South Africa. Frank B. Knight. Illustrated description of interesting mechanical appliances. 900 w. Mines & Min—May, 1900. No. 34006 C.

Mine Dams. James McNaughton. Read before the Lake Superior Min. Inst. Describes how they are built to withstand heavy pressures in the iron-mining district of Michigan. 2000 w. Mines & Min—May, 1900. No. 34009 C.

The Lagrange Dam, California. E. H. Barton. Detailed description of the dam and its construction. 2200 w. Trans Am Inst of Min Engs—Sept., 1899. No. 34032 D.

Docks.

The Thames Docks. An editorial explanation of their unsatisfactory condition and the problems to be solved. 2500 w. Engng—May 18, 1900. No. 34465 A.

Drainage.

Drainage of the Valley and City of Mexico. Willis B. Wright. Historical review of the drainage of the city, and description of the new drainage and sewerage systems under construction. Map. 2200 w. Jour Assn of Engng Socs—April, 1900. No. 34409 C.

The Drainage and Protection of the Philadelphia Lowlands. Harrison Souder. Illustrated description of these lands and the methods used. Discussion. 4000 w. Pro of Engs' Club of Phila—May, 1900. No. 34299 D.

Drainage Canal Difficulties. Hearing of the vessel interests and Chicago representations by the Sec. of War. 2500 w. Marine Rev—May 24, 1900. No. 34420.

Dredging.

Deep Sea Dredges and Dredging. Waldon Fawcett. Illustrated description of sea-going vessels that can dredge and dump 9,000 tons of sand a day. 1700 w. Am Mfr & Ir Wld—May 24, 1900. No. 34424.

Electrolysis.

Electrolysis in Peoria. Dabney H. Maury. Abstract of a paper before the Richmond convention of the Am. Water-Works Assn., on the damage done to pipes and standpipes by current from electric railways. 1700 w. Eng Rec—May 19, 1900. No. 34331.

Filter Crib.

The Filter Crib of the Allegheny Water Works. Illustrated description, with information concerning the construction and working. 900 w. Eng News—May 17, 1900. No. 34312.

Filtration.

Filtration of the Washington Water Supply. Reviews the experiments made to ascertain the best method of removing the high bacteria and turbidity characteristics of the Potomac River water, which led to a recommendation to build a mechanical filter plant. 3000 w. Eng Rec—May 12, 1900. No. 34280.

Iron as a Coagulant for Mechanical Filters. Review of a paper by Dow R. Gwinn before the Am. Water Wks. Assn., on the methods used for coagulation at Quincy, where the raw water does not have sufficient carbonate of lime to allow the use of sulphate of alumina. 1000 w. Eng Rec—May 19, 1900. No. 34376.

The Norfolk Mechanical Filter Plant. Review of a paper by E. B. Weston before the Am. Water Wks. Assn. on an 8,000,000-gal. plant for the removal of color and turbidity from a swampy water. The coagulation and sedimentation take place in a reservoir outside the filter house, instead of in the sedimentation chambers of each filter tank. 1800 w. Eng Rec—May 19, 1900. No. 34334.

The Removal of Iron from Water by

the Linde-Hess Process (Die Wasser-Enteisenung nach dem Verfahren von H. v. d. Linde und Dr. C. Hess). An illustrated description of this process, in which there is a filter, filled with sawdust impregnated with zinc oxide. 1500 w. Gesundh Ingenieur—April 15, 1900. No. 34157 B.

Flow.

A New Hydraulic Criterion. A statement of a simple test of the accuracy of experiments on the flow of water in channels, and of its use to detect errors in results otherwise not noticeable. 900 w. Eng Rec—May 5, 1900. No. 33992.

On the Flow of Water Over Dams. Discussion of paper by George W. Rafter. 7700 w. Pro Am Soc of Civ Engs—May, 1900. No. 34396 E.

Harbor Improvements.

Removal of Rocks in San Francisco Harbor. Illustrated description of one of the largest enterprises of this kind on record. 1100 w. Min & Sci Pr—May 12, 1900. No. 34293.

Removing Submerged Rock in San Francisco Harbor. Illustrated description of a drilling platform, hung like a derrick arm from a gin post erected on top of the rocks to be blasted; the drills were of the oil-well type. 600 w. Eng Rec—May 26, 1900. No. 34431.

The Story of the Savannah Harbor Work. Eeditorial review of the work on which Capt. Carter was engaged, and the evidence upon which he was pronounced guilty. 4800 w. Eng News—May 10, 1900. No. 34227.

Irrigation.

Irrigation Studies. Elwood Mead. Extracts from the report of the U. S. Dept. of Agriculture, concerning methods of distributing and using water in irrigation. 6600 w. Pro Am Soc of Civ Engs—May, 1900. No. 34394 E.

Irrigation Works on the Nile. An illustrated account of the progress made in the great engineering work of constructing the Assouan dam and reservoir. 2200 w. Engr, Lond—May 11, 1900. Serial. 1st part. No. 34369 A.

Isthmian Canal.

Difference of Opinion on an Isthmian Canal. Gives opinions expressed by Jas. D. Phelan, and by C. P. Huntington. 1800 w. Ry & Engng Rev—May 19, 1900. No. 34354.

Silico Lake Railway, and the Greytown Breakwater of the Nicaragua Canal Co. Illustrated descriptions furnishing facts of interest bearing on the construction of the Nicaragua Canal. 450 w. Eng News—May 17, 1900. No. 34316.

Locks.

The Hotopp Syphon Locks on the Elbe-Trave Canal. Illustrated detailed description of the locks and their operation. 3000 w. Engng—May 4, 1900. No. 34246 A.

Mains.

Repairing a 30-Inch Submerged Water Main. D. W. French. Abstract of paper before the Am. Water Wks. Assn., describing the lifting of the pipe from a temporary pile trestle and substituting new lengths for those broken. 1700 w. Eng Rec—May 19, 1900. No. 34333.

Nicaragua.

See Isthmian Canal, above.

Panama.

See Isthmian Canal, above.

Pipe Coatings.

Asphalt Coatings for Water Pipe. Information concerning the material known as "mineral rubber" asphalt. 1300 w. Eng News—May 17, 1900. No. 34315.

Rainfall.

Rainfall in Cities Considered with Reference to the Design of Sewers (Ueber die den Stadt Entwässerunganlagen zu Grunde zu Legenden Regenmengen mit Besonderer Berücksichtigung der Verzögerung im Abflusse derselben). Ed. Bodenseher. A very complete treatment of the subject, paying special attention to the retardation of the flowing off of rain water from the surfaces on which it falls. Tables and diagrams. 7500 w. Zeitschr d Oest Ing u Arch Ver—April 20. 1900. No. 34138 B.

Richmond, Va.

Richmond's Model Water System. An illustrated detailed description of the municipal plant. 2000 w. Fire & Water—May 12, 1900. No. 34276.

Sault Ste. Marie.

The Sault Power Canal. Waldon Fawcett. An illustrated account of this project, which will supply an immense amount of power, rivaling Niagara. 1400 w. Sci Am—May 26, 1900. No. 34405.

Stand-Pipes.

The Failure of the Stand-Pipe at Elgin, Ill. William D. Pence. An illustrated account, giving information relative to the stand-pipe and its failure, with discussion of the cause. Also other reports. 5500 w. Eng News—May 3, 1900. No. 33975.

Syracuse.

Syracuse Water Supply. James H. Hamilton. Reviews the benefits derived from municipal ownership. 3500 w. Munic Af—March, 1900. No. 34245 C.

Water Meters.

Experience with Water Meters at Lexington, Ky. Abstract of paper before the Am. Water Wks. Assn., by S. A. Charles, describing the operation of the meter system in a city with 99 per cent. of the

services metered. 800 w. Eng Rec—May 19, 1900. No. 34335.

Water Purification.

Mechanical Filtration, Vincennes, Indiana. Illustrated description of a plant of 2,000,000 gals. daily capacity, containing a number of new features for controlling the operations and washing the sand. 1800 w. Eng Rec—May 5, 1900. No. 33995.

Water Purification at Vincennes, Ind. Illustrated description of this plant, with statement of the conditions to be met. 2500 w. Eng News—May 3, 1900. No. 33978.

Water Storage.

Water-Storage Systems at Fort Terry and Lacona. Illustrated description of two small works noteworthy for the use of tanks under air pressure as a substiture for standpipes. 900 w. Eng Rec—May 26, 1900. No. 34433.

Waterway.

A Proposed Waterway from Lake Michigan to the Mississippi River. Extract from the memorial submitted to Congress favoring the construction of this waterway by the Federal government. Also a project to enlarge the Illinois and Michigan canal is discussed. 2800 w. Eng News—May 3, 1900. No. 33976.

Water-Works.

Recent Events at the Castlewood Dam. Illustrated description of the heavy flow of water through a rock-fill dam 70 ft. high without washing it out. 1400 w. Eng Rec—May 19, 1900. No. 34330.

Wells.

Protection to Well-Water Supply. H. Etheridge. Illustrates and describes a device for straining water filtered through sand, and thus overcoming the destructive effects on machinery. 900 w. Fire & Water—May 12, 1900. No. 34277.

MATERIALS.

Building Stones.

Building and Ornamental Stones of Texas. From late reports of E. T. Dumble. Information concerning valuable deposits. 1800 w. Stone—May, 1900. No. 34301 C.

Cement.

Plant of the Lawrence Cement Company of Pennsylvania. Illustrated description of Portland cement works recently started near Siegfried, Pa., where particular attention was paid to the arrangement of the machinery and the plans for handling the materials, so as to avoid the use of labor as far as possible. 4800 w. Eng Rec—May 12, 1900. No. 34279.

Slag Adulteration of Portland Cement. Halbert L. Chipps. A brief account of experimental investigations. 800 w. Tech. No. 14—1899-1900. No. 34385 D.

The Cement Age. G. W. Percy. Historical review of the use and manufacture of cement, its endurance and remarkable qualities. 5000 w. Jour Assn of Engng Socs—April, 1900. No. 34410 C.

The Influence of the Rotary Kiln on the Development of Portland Cement Manufacture in America. Interesting discussion of the cause of the United States' slow development in the manufacture of cement, and then the rapid development all at once, with much information. 3000 w. Eng News—May 3, 1900. No. 33977.

The Manipulation of Cement Tests. A review of the replies received by a special committee of the Am. Soc. C. E. to a circular letter for information concerning the best methods of making cement tests. 3300 w. Eng Rec—May 5, 1900. No. 33997.

Cement Walks.

Letters to the Editor Concerning Cement Walks. A discussion of the causes of failure in such walks and suggested remedies. 2700 w. Eng Rec—May 12, 1900. No. 34284.

Metal Protection.

See Architecture and Building.

Steel Specifications.

See Mining and Metallurgy, Iron and Steel.

Timber Preservation.

A Proposed Method for the Preservation of Timber. F. A. Kummer. Describes experiments made with a view of improving the creosoting process. 4400 w. Pro Am Soc of Civ Engs—May, 1900. No. 34393 E.

Preservative Treatment of Timber. O. Chanute. Information concerning the processes tried and results attained; the work as carried on in Europe, and the processes in vogue. Discussion. 15500 w. Jour W Soc of Engs—April, 1900. No. 33922 D.

MUNICIPAL.

Bacteria.

The Utilization of Bacteria and Bacteriological Methods in Sanitary Engineering. A. C. Abbott. Calls attention to various devices favoring the application of this process in the purification of water-supply and the disposal of waste. 6800 w. Pro of Engs' Club of Phila—May, 1900. No. 34296 D.

Garbage Crematory.

The Thackeray Garbage Furnaces at San Francisco, Cal. F. J. Mills. Illustrated description of the largest single plant for burning garbage in the United States, and possibly in the world, with editorial comment. 4700 w. Eng News—May 17, 1900. No. 34310.

Municipal Supply.

Municipal Light, Heat, and Power. Alton D. Adams. A comparison of the results obtained by gas and electric energy. 2700 w. Munic Engng—May, 1900. No. 33925 C.

Paris.

Paris From a Sanitary Engineering Standpoint (Die Stadt Paris vom Gesundheitstechnischen Standpunkte). Hermann Beraneck. A general account, with some details of the sewage, water supply, street cleaning, etc., and two plans. 4000 w. Zeitschr d Oest Ing u Arch Verein—April 27, 1900. No. 34140 B.

Pavements.

Pavements and Vitrified Brick in Washington, D. C. Discusses asphalt and vitrified brick as materials for paving. 2000 w. Brick—May 1, 1900. No. 34077.

Paving Tests.

Asphalt Paving Tests. F. E. Puffer. Explains simple tests that may be undertaken by city engineers. 1000 w. Munic Engng—May, 1900. No. 33924 C.

Rapid Transit.

Contracts and Quantities in the New York Rapid Transit Railway Work. Editorial giving figures showing the enormous quantity of engineering material to be consumed in carrying out this great project. 2200 w. Eng News—May 24, 1900. No. 34413.

Sewage Disposal.

Sewage Treatment at Acton, England. James H. Fuertes. Illustrated description of a plant for a town of 7,000 people, where ferozone is used as a coagulant and polarite as a filtering material. 600 w. Eng Rec—May 5, 1900. No. 33994.

Sewage Disposal at Mendota, Ill. Illustrated description of the first system of intermittent filtration in the State, with a summary of the chemical analyses of sewage and effluent. 900 w. Eng Rec—May 26, 1900. No. 34432.

Sewerage.

Apportioning the Expenses of Joint Sewerage Works. A review of a method like that of clearing house settlements, making each part-owner of the works pay in proportion to the amount of sewage and ground water contributed, and its advantage in location. 1000 w. Eng Rec—May 26, 1900. No. 34428.

Operation of the Berlin Sewerage System and Sewage Farms for the Year 1898-9. Allen Hazen. Abstract from *Verwaltungs-Bericht des Magistrats zu Berlin.* 700 w. Eng News—May 24, 1900. No. 34414.

The New Sewerage and Sewage Disposal Works of the Borough of Southampton. W. B. G. Bennett. A description of the new works, with map. Also discussion. 6800 w. Jour San Inst—April, 1900. No. 34241 E.

Street Cleaning.

Street Cleaning in Dresden (Die Strassenreinigung Dresdens). A general account of methods and results. 2500 w. Gesundh Ingenieur—April 15, 1900. No. 34158 B.

MISCELLANY.

Engineering Competition.

American and British Industries (L'Industrie Américaine et l'Industrie Anglaise). E. Biard. A review of the recent discussion in *Engineering*, from a French standpoint, with curves and tables. 12000 w. Bull de la Soc d'Encour—April 30, 1900. No. 34179 G.

Graphical Methods.

A Graphical Method for Calculating the Flat Base Frame of Framework Structures (Graphische Methode der Berechnung des Flachen Fussringes Räumlicher Fachwerke). Prof. Felix Jasinski. A mathematical article, with numerous diagrams. 2500 w. Schweiz Bauzeitung—May 5, 1900. No. 34164 B.

Graphical Solutions of Certain Problems in Engineering. F. H. Hummel. Abstract of a paper read at the meeting of the Soc. of Civ. and Mech. Engs. Deals with problems where the reasoning may be assisted and the results obtained by graphic constructions. 2200 w. Prac Engr—April 20, 1900. No. 33907 A.

Manchuria.

Russia's Opening for Anglo-Saxon Enterprise in Asia. A. H. Ford. Personal observations of the startling railway developments of Eastern Asia, the markets for machinery and engineering construction there afforded, and the rising competition of Japan. 4500 w. The Engineering Magazine—June, 1900. No. 34492 B.

Surveys.

Recent Stadia Topographic Surveys. Notes Relating to Methods and Cost. Discussion of paper by William B. Landreth. 7000 w. Pro Am Soc of Civ Engs—May, 1900. No. 34395 E.

Transition Curves.

Railway Transition Curve Tables for Field Use. F. K. Vial. Describes short methods for developing curve tables for field use for the several transition curves and explains their application to special field problems. 3800 w. Tech. No. 14—1899-1900. No. 34391 D.

Uniform Chord Length Method for the Railway Transition Spiral. Arthur N. Talbot. Describes method and presents a general table. 1600 w. Tech. No. 14—1899-1900. No. 34392 D.

ELECTRICAL ENGINEERING

COMMUNICATION.

Boiler Telegraph.

Electric Boiler Telegraph (Elektrischer Kesseltelegraph). An illustrated description of a Siemens-Halske apparatus for sending various signals to and from the boiler room of a ship. 800 w. Elektrizität—April 14, 1900. No. 34173 C.

Cables.

Construction of a Trans-Pacific Cable. Presents the arguments against a government-owned cable, and favorable to private ownership; also arguments against private control. 2300 w. Marine Rev—May 3, 1900. No. 33986.

Special Apparatus for Testing Cables Rapidly and Accurately. Henry W. Fisher. Illustrates and describes a set of cable-testing apparatus embodying insulation by direct reflection, electrostatic capacity by throw, and conductor resistance by Wheatstone bridge. 2500 w. Elec Wld & Engr—May 12, 1900. No. 34287.

Some Aspects of the Pacific Cables Question. Frederick Trimmer. Presents some features of interest from the American point of view, and others from foreign standpoints, mostly of the business aspects. 1500 w. Elec Wld & Engr—May 26, 1900. No. 34421.

Space Telegraphy.

Wireless Telegraphy. W. L. Howard. Reviews the Preece system and the Marconi system, and the trials in the U. S. navy. Ill. 3200 w. Marine Rev—May 17, 1900. No. 34319.

Specifications.

Pole Line Specifications of the Federal Telephone Company, of Pittsburg, Pa., for Use When Contracting for the Construction of Telephone Trunk or Toll Lines. Prepared by F. J. Dommerque and Fred. de Land. 3500 w. Tel Mag—May, 1900. Serial. 1st part. No. 34446.

Telegraph-Telephone.

Simultaneous Telegraphy and Telephony. F. Walloch, in *Elektrotechnische Zeitschrift.* Illustrated description of a system used in the Berlin Fire Department. 1800 w. Tel Mag—May, 1900. No. 34447.

Telephone Cut-Out.

The Use of the Blut Automatic Cut-Out Apparatus in Connecting Local Stations with the Main Lines of the German Telephone System (Einrichtung von Nebenstellen im Anschluss an die Fernsprechapparate der Reichspost unter Verwendung von Automatischen Sperrvorrichtungen System Blut). H. Blut. Paper read before the *Elektrotechnischer Verein,* giving an account of this semi-automatic apparatus, with illustrations. 4500 w. Elektrotech Zeitschr—April 19, 1900. No. 34111 B.

Telephones.

Interior Telephone Systems. W. S. Henry. Illustrates and describes systems that may be used for house, office, or factory buildings. 2300 w. Am Elect'n—May, 1900. Serial. 1st part. No. 33941.

The Telephoning of London by the Post Office. Particulars of the areas to be served and the exchanges to be established, the cables, conduits, manholes, switchboards, and method of working to be adopted. Ill. 1300 w. Elec Rev, Lond—May 11, 1900. Serial. 1st part. No. 34361 A.

Municipal Telephone in Amsterdam. Ph. Falkenburg and J. H. van Zanten. An account of a successful example. 1800 w. Munic Af—March, 1900. No. 34242 C.

Toll Lines.

Toll Lines. Their Construction, Equipment and Operation. W. T. Heddon. Discussion of the best practice. Ill. 2200 w. Tel Mag—May, 1900. No. 34448.

DISTRIBUTION.

Equalizers.

Voltage Equalizers for Three-Wire Systems. F. S. Hickok. Considers the necessity for such devices and the conditions which have influenced their development, giving a description of various methods that have been tried. 3200 w. W Elect'n—May 5, 1900. No. 34091.

Paris Exposition.

Distribution of Electrical Energy at the Paris Exposition (Fourniture de l'Energie Electrique Necessaire aux Divers Services et aux Installations Particulières). J. A. Montpellier. A general description, with some of the Exposition rules and regulations. 1400 w. Electricien—April 28, 1900. No. 34196 B.

Distribution of Electrical Energy and Electric Lighting at the Paris Exposition (Distribution de l'Energie Electrique dans l'Enciente de l'Exposition. Eclairage des Palais et des Jardins). Emile Cayla. An illustrated general description. 1 plate. 3000 w. Génie Civil—May 5, 1900. No. 34183 D.

Rotaries.

Rotary Converters. Hans Sigismund

Meyer. Translated from *Elektrotechnische Zeitschrift.* On the practical applications of these machines. 2500 w. Elec Eng, Lond—May 4, 1900. No. 34268 A.

Switch.

High Tension Cut-Out Switch, of Spreches (Hochspannungsausschalter von Sprecher). An illustrated description of a switch for high tension currents, constructed on the principle of a Siemens-Halske lightning arrester. 600 w. Elektrizität—April 28, 1900. No. 34175 C.

Wire Protection.

The Protection of Insulated Wires for Electric Light and Power Inside Buildings. Sydney F. Walker. Considers the requirements and how they may best be fulfilled. 2500 w. Elec Rev, Lond—May 4, 1900. Serial. 1st part. No. 34272 A.

Wiring.

One or Two-Wire Systems of Electric Distribution, Comparatively Discussed. Alton D. Adams. A discussion of the advantages of both systems, showing that the preference for the two-wire insulated circuits on ships seems to be well founded. 3000 w. Marine Engng—May, 1900. No. 34043 C.

The Electric Wiring of Buildings. W. A. Charmen. Considers wiring systems and general arrangements. Also discussion. Ill. 19500 w. Trans Inst of Engs & Shipbuilders in Scotland—Feb., March and April, 1900. 3 parts. No. 34325 each D.

Wiring Tables.

The Theory of the Wiring Table. Thomas G. Grier. An explanation, with illustrations of the application. 1700 w. Min & Sci Pr—April 28, 1900. No. 33983.

ELECTRO-CHEMISTRY.

Accumulators.

Gas Polarization in the Lead Accumulator (Ueber die Gaspolarisation im Bleiakkumulator). W. Nernst and F. Dolezalek. A short discussion of the subject. 900 w. Zeitschr f Elektrochemie—May 10, 1900. No. 34170 G.

The Temperature Coefficients of Lead Accumulators (Ueber den Temperaturkoeffizienten des Blei-Akkumulators). F. Dolezalek. An experimental research, with tables and curves. 1200 w. Zeitschr f Elektrochemie—April 19, 1900. No. 34169 G.

See also Mechanical Engineering, Automobiles.

Copper.

Some Practical Points in the Electro-Deposition of Copper. Alfred F. Bawtree. Read before the students of the Finsbury Tech. College. Discusses the fundamental principles of deposition, and phenomena observed. 1300 w. Elec Rev, Lond—May 11, 1900. No. 34362 A.

Electrolysis.

See under Street and Electric Tramways.

Silicon.

Metalloid (Metalloide). A description of a process, patented in Germany, for the electrolytic production of silicon from a mixture of carborundum and silica. 1000 w. Zeitschr f Elektrochemie—April 19, 1900. No. 34167 G.

ELECTRO-PHYSICS.

Cathode Rays.

Application of Cathode Rays to the Study of Variable Magnetic Flux (Application des Rayons Cathodiques à l'Etude des Flux Variables). M. Aliamet. An illustrated description of Prof. Augström's method of studying changes in a magnetic field by means of its effects upon a cathode discharge 1000 w. Electricien—May 5, 1900. No. 34199 B.

Impedance.

The Impedance of Circuits Having Mutual Induction (Ueber Richtungswiderstände bei Stromkreisen mit Gegenseitiger Induktion). Josef Herzog and Clarence P. Feldman. A theoretical discussion, with diagrams and formulæ. 600 w. Elektrotech Zeitschr—April 19, 1900. No. 34109 B.

Interrupters.

Irregularities in the Operation of the Recent Liquid Interrupters (Die Unregelmässigkeit der Unterbrechungen bei den Neueren Flüssigkeitsunterbrechern). Ernst Ruhmer. A mutoscopic investigation of the operation of Wehnelt and Simon interrupters, with illustrations and curves. 1800 w. Elektrotech Zeitschr—April 26, 1900. No. 34114 B.

The Indications of Commercial Instruments on Wehnelt Interrupter Circuits. George T. Hanchett. An account of experiments made and conclusions reached, showing how deceptive are measuring instruments, and explaining the conditions in a direct-current circuit including a Wehnelt interrupter. 2500 w. Elec Wld & Engr—May 5, 1900. No. 34027.

Long Sparks.

Apparatus for the Production of Powerful Electrical Effects at the Paris Exposition (Exploseur Rotatif et Dispositifs Divers pour la Production de Puissants Courants à Haute Frequence). A. d'Arsonval. Description of apparatus for producing decorative effects on the façade of the Electricity Building. 1500 w. Electricien—May 5, 1900. No. 34198 B.

Radiation.

Negative Electrification of the Secondary Rays Produced by Means of Röntgen Rays (Electrisation Negative des Rayons Secondaires Produits au Moyen

des Rayons Röntgen). P. Cunie and G. Sagnac. A communication to the French Academy describing experiments which show the negative electrification of the secondary rays, with illustrations. 700 w. Comptes Rendus—April 9, 1900. No. 34193 D.

Note on the Transmission of the Radiation from Radium through Bodies (Note sur la Transmission du Rayonnement du Radium au Travers des Corps). H. Becquerel. A communication to the French Academy reviewing some experiments and discussing hypotheses. 1500 w. Comptes Reudus—April 9, 1900. No. 34190 D.

The Duration of the Emission of Röntgen Rays (Sur la Durée d'Emission des Rayons Röntgen). Bernard Brunhes. A communication to the French Academy describing experiments modeled on those of Wheatstone, by which the duration of emission is found to be of the order of one ten-thousandth of a second. 900 w. Comptes Rendus—April 9, 1900. No. 34191 D.

The Reflection and Refraction of Cathode Rays and of Deviable Radium Rays (Sur la Réflexion et la Réfraction des Rayons Cathodiques et des Rayons Déviables du Radium). P. Villard. A communcation to the French Academy describing experiments which seem to confirm J. J. Thomson's hypothesis of a secondary emission. 600 w. Comptes Rendus—April 9, 1900. No. 34192 D.

GENERATING STATIONS.

Boilers.

Boilers for Electric Power Plants. R. A. Douglass. Calls attention to things to be considered in deciding the question. 3400 w. Am Elect'n—June, 1900. No. 34451.

Boston Station.

The Boston Electric Light Company's Central Station. Illustrated description of a modern steam driven plant, distributing direct current for series arc lighting and alternating current for incandescent lighting and power purposes. 4000 w. Elec Rev, N. Y.—May 16, 1900. No. 34344.

Coal Handling.

Handling Coal in Central Stations. James Francis. Considers plants of more than 2000 h. p. output; those of 500 to 2000 h. p. output; and plants of less than 500 h. p. output, describing and illustrating various systems. 2200 w. Am Elect'n —June, 1900. No. 34453.

Chicago.

The Central Station Situation in the City of Chicago. Illustrated description of the arrangements for lighting the city and suburban districts, especially discussing the latter. Also editorial. 8800 w. Elec Wld & Engr—May 19, 1900. No. 34342.

Dynamo.

Siemens-Halske 2000 Kilowatt Rotary-Current Dynamo at the Paris Exposition (Die Elektricität auf der Pariser Weltausstellung. — Drehstrommaschine von 2000 K. W. von Siemens & Halske A.-G.). An illustrated account of this machine with stationary armature and rotating field, directly coupled to a Borsig engine. 700 w. Elektrotech Zeitschr—May 3, 1900. No. 34117 B.

The 3000 Horse-Power Steam Dynamo of the Helios Company (Die 3000 PS. Dampfdynamo des Helios Elektricitäts-Aktiengesellschaft in Köln-Ehrenfeld). Dr. M. W. Hoffmann. A well illustrated description of this great rotary current generator, exhibited at Paris. 1400 w. Glaser's Annalen—May 1, 1900. No. 34122 D.

Progress in Dynamo Construction (Neuerungen im Bau von Dynamomaschinen). A review of the present state of the art, taking up the various parts of the machine in order. Serial. 1st part. 1600 w. Elektrizität—April 28, 1900. No. 34177 C.

Automatic Regulation of a Dynamo by Varying the Air Space (Dynamomaschine mit Selbstthätiger Regelung durch Verändern des Luftraumes). An illustrated description of a dynamo with field magnets whose distance from the armature can be varied. 800 w. Elektrizität—April 14, 1900. No. 34172 C.

Electrical Equipment.

Electrical Equipment for Small Central Stations. L. B. Mather. Discusses various arrangements for varying conditions. 2200 w. Am Elect'n—June, 1900. No. 34457.

Engines.

The Selection of an Engine for a Power Station. R. C. Carpenter. A discussion of types, with the conclusion that it is probable that the compound condensing engine is the type best adapted for power-house work under present conditions. 1800 w. Am Elect'n—June, 1900. No. 34450.

Foundations.

Foundations for Electrical Machinery. P. I. Panamolo. The importance of substantial foundations and the disastrous results from settling. Ill. 1500 w. W Elect'n—April 28, 1900. No. 33959.

German Station.

A Modern German Station. John R. Dick. Illustrates and describes the municipal station at Dortmund. 1800 w. Elect'n, Lond—May 4, 1900. Serial. 1st part. No. 34270 A.

Induction Motors.

Some Points About Induction Motors. W. T. Morrison. Facts as to current, etc., showing what can be expected of these motors. Ill. 1600 w. Am Elect'n—June, 1900. No. 34458.

Paris Exposition.

The Electric Plant on the Champ de Mars (Installation des Groupes Electrogènes au Champ-de-Mars). Emile Cayla. An illustrated general description of the electric generating plant at the Exposition. 2000 w. Génie Civil—April 21, 1900. No. 34180 D.

Electric Light and Power at the Paris Exposition. Illustrated description of the electricity building, generating plant and general arrangements. 6000 w. Elec Wld & Engr—May 19, 1900. No. 34343.

The Power Generating Plant at the Paris Exposition Comprising Typical Examples of European Engineering. Illustrated detailed description. 4000 w. Am Elect'n—June, 1900. No. 34449.

Piping.

The Arrangement of Central-Station Piping. William D. Ennis. Considers the arrangement in a small lighting plant, and also for a 500 h. p. station. Ill. 3000 w. Am Elect'n—June, 1900. No. 34455.

Reconstruction.

Extension and Reconstruction of Central Stations and Distributing Systems. Peter Junkersfield. Considers some of the latest developments in central station work in the United States, particularly with reference to extension and reconstruction of existing plants. 5400 w. Tech. No. 14—1899-1900. No. 34382 D.

Stoking.

Stoking in Central Stations. James F. Hobart. Illustrates and describes some of the best known types of mechanical stokers. 1800 w. Am Elect'n—June, 1900. No. 34452.

Switzerland.

The Electric Plant of the *Société des Forces Motrices de l'Avançon* in Bex, Canton Waadt (Das Elektricitätswerk der Société des Forces Motrices de l'Avançan in Bex, Waadt). K. A. Breüer. A well illustrated account of this plant, which gets power from the Avançon River, and distributes light and power and operates a tramway. Serial. 1st part. 1500 w. Schweiz Bauzeitung—April 14, 1900. No. 34162 B.

Transformers.

Inductive E. M. F. in Transformers. John B. Whitehead, Jr. Deals with the graphic representation of the drop of pressure, and with the algebraic estimation of the inductive drop as dependent upon the relative association of the primary and secondary coils. 2000 w. Elec Wld & Engr—May 5, 1900. No. 34026.

LIGHTING.

Arc Lamp.

Arc Lamp with Inclined Carbons Bagenlamp mit Schräg gegen Einander Gestellten Kohlen). An illustrated description of a lamp in which the carbons are inclined to each other at a small angle with the horizontal and are kept at the proper distance apart by a non-conducting block. 500 w. Elektrizität—April 28, 1900. No. 34176 C.

A Comparison of Open and Enclosed Arc Lamps for Street Lighting. H. H. Wait. A review of some of the principal points. 2500 w. Am Elect'n—June, 1900. No. 34456.

Incandescence.

The Weak Spot in Incandescent Electric Lighting from Central Stations. Francis W. Willcox. A discussion of the lamp question, advocating free supply and regular renewal. 2200 w. Am Elect'n—May, 1900. No. 33939.

Johannesburg.

Electric Lighting in Johannesburg. J. R. Cowell. Read at meeting of the South African Assn.of Engs. A few questions of local interest are discussed and regularity of supply, cost, etc., considered. 2000 w. Archt, Lond—April 20, 1900. No. 33908 A.

Malta.

The Electric Light Plant of Malta. R. W. Ashcroft. Illustrated description. 900 w. Elec Wld & Engr—May 26, 1900. No. 34422.

Photometry.

See under Measurements, below.

Street Lighting.

Arrangement of Incandescent Street Lamps. Alton D. Adams. A discussion of this subject, showing the incandescent lamps are satisfactory and economical when the right methods are used. 1400 w. Elec Rev, N. Y.—May 16, 1900. No. 34345.

MEASUREMENT.

Alternating Currents.

Tracing Alternating Current Curves by Instantaneous Contact Methods (Die Punktweise Aufnahme von Wechselstromkurven). Dr. F. Niethammer. Criticising different methods and expressing preference for that of Joubert, with condenser and ballistic galvanometer; with diagrams. 400 w. Elektrotech Zeitschr—April 19, 1900. No. 34110 B.

Computator.

A Mechanical Computator for Alternating Current Circuits. William Hand Browne, Jr. Explains the principle and construction of an instrument for solving

mechanically any wiring problem for direct currents and its application to alternating currents. 1000 w. Tech, No. 14—1899-1900. No. 34384 D.

Magnetic Tests.

Magnetic Tests of Sheet Iron (Die Magnetische Prüfung von Eisenblech). I. Epstein. An account of tests by practical and accurate methods, with tables, diagrams and illustrations. 2500 w. Elektrotech Zeitschr—April 19, 1900. No. 34108 B.

Oscillograph.

The Duddell Oscillograph. An illustrated detailed description of an electrical measuring apparatus. 1300 w. Engng—May 4, 1900. No. 34247 A.

Photometry.

Photometry for Central Stations. Lyman C. Reed. Part first describes various photometers. 1500 w. Am Elect'n—May, 1900. Serial. 1st part. No. 33940.

POWER APPLICATIONS.

Electric Driving.

Systems and Efficiency of Electric Transmission in Factories and Mills. William S. Aldrich. Considers the conditions where electric driving is an advantage and the fields it best serves, its efficiency, systems of distribution, and economies effected. 4200 w. Trans Am Soc of Mech Engs. No. 858—May, 1900. No. 34098 C.

The Development of the Electric Drive for Cotton Mills. Extracts from a paper by Sidney B. Paine, read before the Southern Cotton Spinners' Assn., giving facts of general interest to engineers. 1100 w. Eng News—May 17, 1900. No. 34314.

Elevators.

Automatic Reversing and Starting Resistances for Electric Elevators (Selbstthätige Umkehr-Anlasswiderstände für Elektrische Aufzüge). An illustrated description of apparatus used in connection with motors for operating electric elevators. 700 w. Elektrizität—April 28, 1900. No. 34174 C.

Mining Uses.

See Mining and Metallurgy, Mining.

Portable Motors.

Portable Electric Motors, Protected Against Dust and Dirt (Fahrbare, gegen Staub und Schmutz geschützte Elektromotoren). Ernst Schulz. A short illustrated description of a portable motor. 500 w. Glückauf—May 12, 1900. No. 34154 B.

Railway Work.

Electricity as a Motive Power on Railways (Die Elektricität als Zugkraft auf Eisenbahnen). H. Frahm. An illustrated account of the application of electric power for heavy railway work, with descriptions of some electric locomotives. Two articles. 8500 w. Stahl und Eisen—April 15, May 1, 1900. No. 34128 each D.

Speed Regulation.

Regulation of Variable Speed Motors by Varying Impressed and Counter E. M. F's. L. B. Mather. Illustrates and describes several systems that may be used advantageously. 1200 w. Am Elect'n—May, 1900. No. 33936.

Rheostat, Double Commutator and Multi-Voltage Control. Alton D. Adams. Illustrates and describes various means of special regulation and the work to which they are suited. 4500 w. Am Elect'n—May, 1900. No. 33935.

Speed Control of Motors Driving Printing Presses and Machine Tools. Illustrates and describes satisfactory methods. 1000 w. Am Elect'n—May, 1900. No. 33937.

Starting Resistances.

The Graduation of Starting Resistances for Direct-Current Motors (Die Stufung von Anlassern für Gleichstrommotoren). Rudolf Krause. Directions for the proper design of starting resistances, with diagrams and formulæ. 600 w. Elektrotech Zeitschr—April 26, 1900. No. 34113 B.

Works.

Electric Distribution of Power as Applied to Works and Factories. George Harland Bowden. Read before the Glasgow Univ. Engng. Soc. Discusses the economy and increased efficiency, giving results obtained in important works. 3200 w. Elec Eng, Lond—April 27, 1900. Serial. 1st part. No. 34057 A.

TRANSMISSION.

Long Distance.

On Distant Electric Power Transmission. George Forbes. Read before the Inst. of Elec. Engs. Describes selected plants, and their points of interest, and the problems of attaining the highest economy. Discussion. 6700 w. Elec Eng, Lond—May 4, 1900. Serial. 1st part. No. 34269 A.

Wire Tension.

Tables for Designing Aerial Electric Wires in Tension (Abaques Pour le Montage des Lignes Electriques Aériennes). Ed Liégeois. Tables, formulæ and explanation. 1000 w. Génie Civil—May 12, 1900. No. 34188 D.

MISCELLANY.

Address.

The Relations between Electricity and Engineering. William Henry Preece. The "James Forrest" Lecture, delivered before the Inst. of Civ. Engs. Considers the uses to which electricity has been, and may be put to achieve engineering results. 6500 w. Elec Eng, Lond—April 27, 1900. No. 34056 A.

Agriculture.

Application of Electrical Energy to Agriculture (L'Application de l'Energie Electrique à l'Agriculture). Paul Renaud. An illustrated general article on various applications of electric motors to farm work. Serial. 1st part. 1600 w. Electricien—April 28, 1900. No. 34197 B.

Applied Electricity.

Applications of Electrical Science. G. F. Fitzgerald. Abstract of address to the Dublin Section of the Inst. of Elec. Engs. Brief review of the history of applied electricity, its progress, etc. 2300 w. Nature—May 10, 1900. No. 34364 A.

Carbon.

The Properties of Carbon in Electrical Work. Elihu Thomson. The first part of an interesting paper showing the importance and use of carbon in the electrical arts. 2500 w. Elec Wld & Engr—May 12, 1900. Serial. 1st part. No. 34288.

Electrical Equipment.

The Electrical Equipment of the Electrical Engineers' (R. E.), Volunteer Corps. Illustrates and describes the novel equipment sent to South Africa, consisting of traction engines, search lights, limbers, cable drum carriages, and telephones. 2700 w. Elect'n, Lond—April 27, 1900. No. 34053 A.

Electrical Equipment of a Mammoth Packing House. J. E. Smith. Illustrated description of the motive power and refrigerating plant of the Armour establishment. 3700 w. Am Elect'n—May, 1900. No. 33934.

Italy.

Recent Italian Electrical Developments. Giovanni Georgi. An account of electrical enterprises of recent date. 900 w. Elec Wld & Engr—May 5, 1900. No. 34028.

Lightning.

The Protection of Public Buildings from Lightning. Killingworth Hedges. Discusses methods of protection used, and gives suggestions. General discussion. Ill. 11000 w. Jour Roy Inst of Brit Archts—April 28, 1900. No. 34397 B.

Lightning Rods.

Lightning Rods (Ueber Gebäude-Blitzableiter). K. Streeker. Report of a committee of the *Elektrotechnischer Verein*, reviewing the subject, and proposing certain regulations and specifications. 2500 w. Elektrotech Zeitschr—April 26, 1900. No. 34115 B.

Paris Exposition.

Editorial Review of the German Electrical Exhibit at the Paris Exposition, with Plan. 700 w. Elektrotech Zeitschr—May 3, 1900. No. 34116 B.

Electricity at the Paris Exposition of 1900. An illustrated description of the nature and features of this Exposition, especially the electrical exhibits. 9300 w. Elec Wld & Engr—May 5, 1900. No. 34025.

Some Electrical Art Features at the Exposition. Illustrates and describes some electrical decorative features of interest. 1500 w. Elec Wld & Engr—May 26, 1900. No. 34423.

The Electricity Palace at the Paris Exposition (Exposition de 1900. Le Palais de l'Electricité). J. A. Montpellier. A general description of the electrical building and the "Water Chateau," with a plan. 1100 w. Electricien—April 21, 1900. No. 34195 B.

GAS ENGINEERING

Acetylene.

The Present State of the Acetylene and Carbide Industry (Ueber den Heutigen Stand der Acetylen- und Carbid- Industrie). Victor Berdenich. Paper before the *Oesterr Ingenieur-und Architekten-Vercin*, giving an account of the present state of the art in Europe. 5500 w. Zeitschr d Oest Ing u Arch Ver—April 13, 1900. No. 34135 B.

Some Enemies of Acetylene. Discusses ill-designed generators, and other things which have been of harm to this industry. 2500 w. Engr, Lond—April 27, 1900. No. 34070 A.

Address.

President's Address before the Institution of Gas Engineers. J. W. Helps. Considers coal gas and carburetted water gas under present conditions, and discusses the naphthalene difficulty. 7000 w. Gas Wld—May 5, 1900. No. 34249 A.

Benches.

Regenerative Benches. Howard C. Slater. Read at meeting of the Western Gas Assn. Considers their advantages and management. Also general discussion. 5000 w. Am Gas Lgt Jour—May 28, 1900. No. 34442.

Berlin.

The Municipal Gas Works of Berlin (Die Städt. Gaswerke Berlins). Abstract of the report for 1898-99, with tables and general figures. 700 w. Gesundh Ingenieur—May 15, 1900. No. 34161 B.

Calorific Power.

The Calorific Power of Illuminating Gas. Harold G. Colman. Read before the Inst. of Gas Engs. Illustrates and describes Junker's calorimeter, and the manner of making tests. General discussion. 7000 w. Gas Wld—May 5, 1900. No. 34251 A.

Coal Tar.

The Manufacture of Coal Tar Derivatives (Fabrication des Dérivés du Goudron de Houille). A long illustrated article on a variety of coal tar products. Serial. 1st part. 3000 w. Revue Technique—April 25, 1900. No. 34479 D.

Econometer.

Test of Arndt's Gas Weighing Econometer. C. R. Jones and Austin Burt. Describes the apparatus and method of operation and underlying principles, the tests and results. 3000 w. Sib Jour of Engng—May, 1900. No. 34488 C.

Enrichment.

The Carbonization of Cannel and Shales for Gasmaking Purposes. Samuel Glover. Read before the Inst. of Gas Engs. How to make the best use of enrichment material when it is subjected to distillation or decomposition of heat. 6200 w. Gas Wld—May 5, 1900. No. 34255 A.

The Enrichment of Coal Gas. George Livesey. Read before the Inst. of Gas Engs. Considers whether enrichment is advisable. General discussion. 6000 w. Gas Wld—May 5, 1900. No. 34250 A.

Foundations.

Effective and Defective Foundations for Gas Machinery. George D. Rice. Illustrates and notes defects in systems employed, weak floor foundations and the results in gears. 1200 w. Am Gas Lgt Jour—April 30, 1900. No. 33958.

Gas Coal.

Gas Coal: Its Present Price and Effect Upon the Gas Industry. Discussion, opened by R. G. Shadbolt, before the Eastern Counties Gas Mgrs. Assn. 3300 w. Gas Wld—April 21, 1900. No. 33910 A.

Mantles.

The Incandescent Gas Mantle and Its Use. Vivian B. Lewes. Cantor Lecture. An interesting paper reviewing the history of incandescent lighting and the development of Dr. Auer von Welsbach's discovery, giving also suggestions. 5000 w. Gas Wld—May 12, 1900. No. 34366 A.

Meters.

Gas and Gas Meters. Herbert S. Wynkoop. Discusses the causes of poor gas, and the accuracy of gas meters. Ill. 3000 w. Pop Sci M—June 1900. No. 34426 C.

Naphthalene.

The Presence of Naphthalene in Coal Gas. Wilfred Irwin. Read before the Inst. of Gas Engs. Its detection and extraction are discussed, and a table is given showing the condensable constituents of gas produced by a ton of Lancashire coal carbonized at a high temperature, with comments. Lengthy discussion. 8000 w. Gas Wld—May 5, 1900. No. 34254 A.

Retorts.

Inclined Retorts at Bankside. Charles C. Carpenter. Read before the Inst. of Gas Engs. In substituting inclined for horizontal retorts they were designed to fit the existing building. The reasons for adopting the various details are explained. Ill. General discussion. 7500 w. Gas Wld—May 5, 1900. No. 34252 A.

Street Lighting.

Street Lighting by Incandescent Gas Burners. J. H. Sheldrake. Read before the Eastern Counties' Gas Mgrs. Assn. Practical hints to assist those inexperienced, with general information and discussion. 7000 w. Gas Wld—April 21, 1900. No. 33909 A.

Tanks.

Some Examples of Tank Construction. F. W. Stevenson. Read before the Inst. of Gas Engs. Relates experiences in the construction of gasholders and similar tanks. Ill. 2800 w. Gas Wld—May 5, 1900. No. 34256 A.

Water Gas.

Medical Men and Carburetted Water Gas. J. S. Haldane. Extracts from a paper read before the Inc. Soc. of Med. Officers of Health, on the risks attending the use of carburetted water gas for domestic lighting purposes. 3400 w. Gas Wld—April 28, 1900. No. 34051 A.

The Manufacture and Application of Water Gas. Carl Dellwik. Read before the Iron and Steel Inst. An explanation of the theory on which the Dellwik-Fleischer process is based and the results obtained in practice, giving also applications made for manufacturing purposes. Ill. 5000 w. Col Guard—May 11, 1900. No. 34371 A.

Water Gas and Its Recent Continental Developments. Vivian B. Lewes. Read before Inst. of Gas Engs. Reviews the history of water gas, and describes in detail the Dellwik-Fleischer process. 10000 w. Gas Wld—May 5, 1900. No. 34253 A.

MARINE AND NAVAL ENGINEERING

American Marine.

The Upbuilding of the American Merchant Marine. Illustrated description of freight and passenger steamers under construction in the Delaware and the Clyde. 1000 w. Sci Am—May 5, 1900. No. 33968.

Barges.

Schooner Rigged Steel Tow Barges for Deep Water Trade. Illustrates and describes vessels designed especially for this service. 1000 w. Marine Engng—May, 1900. No. 34047 C.

Cable Ship.

The Cable-Laying Ship "Von Podbielski" (Le "Von Podbielski" Navire Poseur de Câbles). A brief general description of this German cable ship, built at Port Glasgow, with illustrations. 800 w. Génie Civil—April 28, 1900. No. 34182 D.

Coaling.

An Apparatus for Coaling at Sea. T. Spencer Miller. Lecture before the Worcester Co. Mech. Assn. An illustrated description of the cableway for coaling at sea, invented by the author. 6000 w. Jour of Worcester Poly Inst—May, 1900. No. 34087 C.

Crank Shafts.

See Mechanical Engineering, Machine Works and Foundries.

Cruiser.

The Imperial Japanese Cruiser "Yakumo." Illustrated descriptive comparison with the "Asama." 350 w. Engr, Lond—May 4, 1900. No. 34258 A.

Destroyer.

H. M. Torpedo-Boat Destroyer "Viper." Leading particulars of the vessel and account of the official trial. 1400 w. Engng—May 11, 1900. No. 34358 A.

Docks.

See Civil Engineering, Hydraulic and Marine.

Engines.

See Marine Engines, under Mechanical Engineering, Steam.

Fire Boat.

Detroit Fire Boat. Illustrated description of a modern vessel of the fire-fighting kind. The pumps have a capacity of 6000 gallons per minute. 600 w. Marine Rev—May 17, 1900. No. 34320.

Floating Dry Dock.

The 15,000-Ton Floating Dry-Dock for the U. S. Naval Station at Algiers, La. Illustrated detailed description, with the reasons which influenced its construction. 2000 w. Eng News—May 3, 1900. No. 33979.

Germany.

German Shipbuilding and Its Allied Industries (Der Deutsche Schiffbau und seine Hülfsindustrien). Prof. Oswald Flamm. A general account of the progress of German shipbuilding, with good illustrations showing the effects of collisions. 2800 w. Stahl und Eisen—May 1, 1900. No. 34130 D.

The Progress of the German Mercantile Marine. Considers the present position and the objects in view, as revealed in the yearly reports of the shipping companies. 2800 w. Engr, Lond—May 11, 1900. No. 34367 A.

Harbor Defence.

Coast and Harbor Defence, with Some Notes on the Spanish War. Caryl D. Haskins. Discusses the problem of defending a coast city under present conditions. 4500 w. Jour of Worcester Poly Inst—May, 1900. No. 34086 C.

Marine Engines.

Engines and Boilers of the "Deutschland." Illustrated description. 400 w. Sci Am Sup—May 26, 1900. No. 34406.

The Naval Steam Engine—Its Graphics and Economics Illustrated. Robert H. Thurston. A study relating to the machinery of the U. S. S. "Maine," and of general efficiency. 2500 w. Marine Engng—May, 1900. No. 34042 C.

Triple Expansion Engines of the Dutch Armoured Cruiser "Noord Brabant" (Machines à Triple Expansion du Croiseur Cuirassé Hollandais le "Noord Brabant"). M. Hachelet. A fully illustrated description of these 10,000 H. P. engines, with general remarks on the Yarrow boilers and the cruiser herself. 1 plate. 3500 w. Génie Civil—May 12, 1900. No. 34186 D.

Modern Navies.

Modern Navies (Les Marines de Guerre Modernes). M. de Chasseloup-Loubat. A full general treatment of the subject. Serial. 1st part. 5600 w. Bull de la Soc d'Encour—March 31 1900. No. 34178 G.

Propeller Shafts.

Corrosion and Failure of Propeller Shafts. A. Scott Younger. Read before the Inst. of Naval Archts. An endeavor to account for the extreme corrosion which is found to occur at the ends of the brass liners on tail-end shafts, with a review of some of the methods that have been suggested to overcome this difficulty. Ill. 3500 w. Engr, Lond—April 20, 1900. No. 33920 A.

Resistance.

On the Influence of Depth of Water on the Resistance of Ships. Giuseppe Rota. Read before the Inst. of Naval Archts. An account of experimental tests carried out in the tank of the Royal Dockyard of Spezia, Italy, giving curves of resistance. 1400 w. Engng—April 20, 1900. No. 33943 A.

Shell Fire.

The Bellisle Experiments. Describes experiments to be made on this battleship to test the effect of modern shell fire on personnel and material. Ill. 1000 w. Engng—May 18, 1900. No. 34469 A.

Shipyard Appliances.

Overhead Cranes, Staging and Riveter-Carrying Appliances in the Shipyard. James Dickie. Illustrated detailed description of the wooden framework in the shipyard of the Union Iron Works in San Francisco. 1500 w. Marine Engng—May, 1900. No. 34044 C.

Speed Record.

An Account of a Record-Breaking Trip Across the Pacific Ocean. William H. Crawford, Jr. An account of fine record made by the steamship "Empress of Japan" in 1897. 1000 w. Marine Engng —May, 1900. No. 34048 C.

Steamboat.

Particulars of the Long Island Sound Steamboat, "Chester W. Chapin." Illustrations, plans and description. 450 w. Marine Engng—May, 1900. No. 34041 C.

Steamer.

New Coastwise Steamers. Illustrated description of the "Chesapeake," just completed for the New York and Baltimore outside line. 1000 w. Naut Gaz—May 17, 1900. No. 34318.

Steamships.

New 18,000 Ton Vessels for the Pacific Mail Steamship Co. Illustrated description of fine steamers being built at the Newport News yard. 1300 w. Marine Engng—May, 1900. No. 34046 C.

New Steamship "Comus." Illustration and description of the Cromwell liner that went into commission this month, running between New York and New Orleans. 1800 w. Naut Gaz—May 24, 1900. No. 34418.

New Type Steamship. Illustrated description of the "Tampico," built at Toledo, Ohio, and designed for ocean as well as lake service. 1500 w. Naut Gaz—May 10, 1900. No. 34218.

Submarine.

The Demonstrated Success of the Submarine Boat. Admiral Philip Hichborn. A review of the history of submarine navigation, of the present state of the art, and of the mechanical and tactical efficiency of the newest craft and their effect on naval construction policy and naval strategy. 5000 w. The Engineering Magazine—June, 1900. No. 34497 B.

Submarine Boats. Editorial comment on the steps taken by France and the United States toward providing for the construction of these boats. Also gives a historical review of experiments made in this field. 2000 w. Engng—April 27, 1900. No. 34060 A.

The Question of Submarine Boats. Edmund Robertson. Discusses England's attitude toward the vessels of this type, questioning its wisdom. 5000 w. Nineteenth Cent—May, 1900. No. 34328 D.

Torpedoes.

Steering Torpedoes by Means of Wireless Telegraphy. F. A. A. Talbot. An account of experiments made by Mr. Varicas, the inventor of the system, with successful results. 900 w. Sci Am—May 12, 1900. No. 34210.

Traffic.

Sea Borne Traffic. James Adamson. Abstract of paper read before the Inst. of Marine Engs. Notes the great improvements in water transportation, the advantages, cost, etc. 1800 w. Ir & Coal Trds Rev—May 4, 1900. No. 34263 A.

Wages.

Wages Paid Mechanics in the Private Shipyards of Foreign Nations. Information of importance from a standpoint of competition in vessel construction. 2200 w. Marine Engng—May, 1900. No. 34045 C.

Warships.

The Electrical Equipment of Ships of War. C. E. Grove. Read before the Inst. of Elec. Engs., England. A discussion of what has been accomplished, and the tendency of the developments. Part first considers dynamos and switchboards. Ill. 1800 w. Elect'n, Lond—April 20, 1900. Serial. 1st part. No. 33911 A.

The Electrical Equipment of Ships of War. Editorial review of the discussion before the Inst. of Elec. Engs. and showing that many appliances are useless in time of battle, and that radical change in the equipment of ships of war is not now advisable. 2500 w. Engng—May 11, 1900. No. 34357 A.

MECHANICAL ENGINEERING

AUTOMOBILISM.

Accumulators.

Competitive Tests of Accumulators (Preisausschreiben auf Akkumulatoren). C. Reimer. An account of the competitive tests made by the Automobile Club of France, from June 3 to Dec. 2, 1899, with a table showing results. 1500 w. Elektrochem Zeitschr—May, 1900. No. 34171 G.

The Treatment of Accumulators for Working Spark Coils. Discusses the management and treatment of the accumulator as a source of current for the various electric sparking appliances that are employed for the ignition of the explosive mixtures in certain classes of oil engines adapted for the propulsion of motor cars. 2000 w. Auto Jour—May 17, 1900. No. 34483 A.

Bollée Vehicle.

The Bollée Voiturette. Illustrated detailed description of a vehicle built on the lines of the tricycle. 2200 w. Sci Am Sup—May 5, 1900. No. 33970.

Combination Systems.

Combination Systems. P. M. Heldt. Description, with two illustrations, of these systems, with remarks on their advantages and disadvantages. 1700 w. Horseless Age—May 9, 1900. No. 34219.

Competition.

The Automobile Club's 1000-Mile Trial. Gives the itinerary and the important features of the vehicles entered. 2500 w. Engr, Lond—April 27, 1900. No. 34073 A.

Gasoline Carriage.

The Georges Richard Voiture. Illustrated description of the latest type. Condensed from *La France Automobile*. 1200 w. Horseless Age—May 16, 1900. No. 34322.

The Packard Gasoline Carriage. Illustrated description. 800 w. Horseless Age—May 16, 1900. No. 34321.

Heavy Duty.

Motor Vehicles for Heavy Traffic. A report of the trials of the Liverpool Self-Propelled Traffic Assn., with illustrations of two of the vehicles. 1600 w. Sci Am Sup—May 12, 1900. No. 34212.

The Automobile Wagon for Heavy Duty. Arthur Herschmann. States the conditions which make these vehicles most desirable, considering the construction, propulsion, etc. Ill. 6500 w. Trans Am Soc of Mech Engs, No. 853—May, 1900. No. 34094 C.

Liquid Fuel Motors.

Liquid Fuel Motors for Vehicles (Fahrzeugmotoren für Flüssige Brennstoffe). Hugo Güldner. A fully illustrated account of many types of liquid fuel motors. Serial. 1st part. 3600 w. Zeitschr d Ver Deutschr Ing—April 28, 1900. No. 34104 D.

Lubrication.

The Lubrication of Motor Vehicles and Cycles. Information from a pamphlet written by J. Veitch Wilson. 1400 w. Auto Jour—May 17, 1900. No. 34481 A.

Mechanical Propulsion.

Road Locomotion. H. S. Hele-Shaw, with appendices by experts. Discusses the general principles of the engineering features of the question; the behavior of the wheel upon the road, steering and turning, motive power and transmission, etc. Ill. 17500 w. Inst of Mech Engs—1900. No. 34088 D.

Military Uses.

War and Power Traction. J. H. A. Macdonald. Read before the Automobile Club. On the great service that could be rendered by successful construction of transport vehicles. 5500 w. Auto Jour—May 17, 1900. No. 34485 A.

Pneumatic Tires.

The Manufacture of a Pneumatic Tire. From *La Nature*. Illustrated detailed description with related information. 2500 w. Sci Am Sup—May 12, 1900. No. 34211.

Steam Carriage.

The Stanley Steam Carriage. Illustrated description. 800 w. Auto Jour—May 17, 1900. No. 34482 A.

Steering.

The Pivot Steering Gear in Practice. P. M. Heldt. Illustrated description. 800 w. Horseless Age—May 2, 1900. No. 33985.

Storage Batteries.

The Selection of a Storage Battery for an Automobile. George T. Hanchett. Gives a method for determining the speed and radius of the vehicle, illustrating by working out the problem for a given vehicle. 500 w. Am Elect'n—June, 1900. No. 34459.

Testing.

Formulæ for Designing and Testing Automobiles (Formelu zur Berechnung und Prüfung von Automobilen). Dr. Walter Kummer. Theoretical discussion of the determination of the efficiency of self-propelling vehicles. 1000 w. Elektrotech Zeitschr—May 3, 1900. No. 34-118 B.

Trials.

The Automobile Club's 1000-Mile Trial. A general account of the vehicles completing the run and of their performance. 2000 w. Engr, Lond—May 18, 1900. No. 34468 A.

The 1000-Mile Trial of the Automobile Club of Great Britain and Ireland. An account of the vehicles, hill climbing records, and speed trials. 7000 w. Auto Jour—May 17, 1900. No. 34484 A.

HYDRAULICS.

Water Power.

Industrial Works at Terni, Italy (Terni Industriel). An article from the *Rivista di Artiglieria e Genio*, giving a general description of various applications of the hydraulic power of the Néra and Vélino rivers, near Terni, Umbria. 5000 w. Revue Technique—April 10, 1900. No. 34477 D.

Water-Wheels.

The Tangential Water-Wheel. W. A. Doble. Reviews the development of open or impulse water-wheel and the results, discussing briefly its adaptability in the engineering field. Ill. 12600 w. Trans Am Inst of Min Engs—Sept., 1899. No. 34040 D.

MATERIALS OF CONSTRUCTION.

Cast Iron.

Burned Iron. Edward Kirk. Its deceptive fracture is discussed, and how it

should be judged. Also remarks on scrap. 1200 w. Foundry—May, 1900. No. 33971.

Malleable Cast Iron.

Annealing Malleable Cast Iron. George C. Davis. Read at meeting of the Foundrymen's Assn. Experiments and results are presented, and the paper is discussed by Richard Moldenke. 2500 w. Foundry—May, 1900. No. 33972.

Steam Metal.

Steam Metal. Erwin S. Sperry, in *The Aluminum World*. The name is applied to a copper alloy used in the manufacture of steam goods. Gives results of experiments, considering its composition, strength, etc. 1300 w. Foundry—May, 1900. No. 33973.

Steel Specifications.

See Mining and Metallurgy, Iron and Steel.

MACHINE WORKS AND FOUNDRIES.

Boiler Making.

Boiler Formers at the Richmond Locomotive and Machine Works. Engravings and table showing method of filing and keeping records of certain locomotive boiler parts. A system devised by Millard F. Cox. 400 w. R R Gaz—May 18, 1900. No. 34350.

Boring Tool.

A Geometric Boring Tool. Illustrated description of a recent device for boring other than round holes. 1700 w. Am Mach—May 3, 1900. No. 33961.

Castings.

Fillets and Round Corners on Castings. John M. Richardson. Read at Pittsburg meeting of the Am. Foundrymen's Assn. Discusses the merits and demerits of fillets, and means of securing good castings. 2500 w. Sci Am Sup—May 5, 1900. No. 33969.

Crane.

The Carl Flohr 25-Ton Electric Travelling Crane at the Paris Exposition (Pont Roulant Electrique de 25 Tonnes de l'Usine Suffren). A well illustrated description of this fine crane in the German section of Machinery Hall. 1 plate. 1500 w. Génie Civil—April 28, 1900. No. 34181 D.

Crank Shafts.

Crank Shafts. John Brady. Considers the construction of stationary and marine crank shafts, the materials used, and their bearings on present-day practice. Ill. 2500 w. Engr, Lond—May 4, 1900. No. 34260 A.

Cupola Practice.

Carbide of Silicon in Cupola Practice—A New Softener. F. J. Tone. The value of this product to the founder, its action, method of handling, etc. 1000 w. Foundry—May, 1900. No. 33974.

Cylinder.

Machining a Steam Cylinder. Illustrated description of the work. 1600 w. Am Mach—May 24, 1900. No. 34399.

Education.

Education of Machinists, Foremen, and Mechanical Engineers. M. P. Higgins. A discussion of the requirements, and questions of interest. 8500 w. Trans Am Soc of Mech Engs, No. 864—May, 1900. No. 34203 C.

Flywheels.

An Outfit for the Manufacture of Large Segmental Flywheels. Illustrations and brief notes relating to the special outfit used by the E. P. Allis Co. 500 w. Am Mach—May 10, 1900. No. 34217.

Gear Cutting.

The Rice Bevel Gear Cutting Machine. An illustrated detailed description of a bevel-gear cutting machine based upon an entirely new principle. 2800 w. Am Mach—May 10, 1900. No. 34216.

Lathes.

Conveniences for a Pattern Maker's Lathe. Illustrates and describes satisfactory attachments used for a number of years. 1000 w. Am Mach—May 24, 1900. No. 34401.

Movement.

A New Mechanical Movement. C. R. Gabriel. Illustrated description of a new movement especially useful in mechanism in which a rotary gear is to be driven for a part of a revolution at a constant speed, and started and stopped without jar. 1200 w. Am Mach—May 17, 1900. No. 34305.

Paris Exposition.

The Paris Exposition of 1900 (Die Weltausstellung in Paris, 1900). A very well illustrated account of some of the principal German exhibits in Machinery Hall, including the Carl Flohr traveling crane, a Borsig engine, a Siemens-Halske dynamo and machine tools. 8000 w. 3 plates. Zeitschr d Ver Deutscher Ing—April 14, 1900. No. 34102 D.

Piece Work.

New Shop Methods a Corollary of Modern Machinery. An editorial showing that labor's opposition to the new wage system is like their former opposition to machinery, and equally futile. Improved machinery and intensified production are parts of the same movement. 1800 w. The Engineering Magazine—June, 1900. No. 34491 B.

Piece Work Not Essential to Best Results in the Machine Shop. James O'Connell. An official statement of the attitude of American organized labor.

3600 w. The Engineering Magazine—June, 1900. No. 34495 B.

Premium Plan.

The Economics of the Premium Plan. F. A. Halsey. Abstract of a lecture before the Providence Soc. of Mech. Engs. An explanation of the system, giving figures and statements from representative concerns in support of arguments in its favor. 3200 w. Am Mach—May 3, 1900. No. 33963.

Screw Threads.

The S. J. Standard Metric Thread in Continental Europe. Henry Hess. Reviews the efforts to secure uniformity in screw threads, and the shape adopted in Continental Europe, giving considerations to be weighed by the American manufacturer who desires to sell in foreign markets. Ill. 1200 w. Am Mach—May 3, 1900. No. 33965.

Shafts.

On Mysterious Fractures of Steel Shafts. R. Schanzer. Read before the Inst. of Nav. Archts. Describes a particular brittle structure observed in a suddenly fractured shaft that was presented for examination. Ill. 4700 w. Engng—April 27, 1900. No. 34062 A.

Shops.

Enlarged Plant of the Bullard Machine Tool Co.—Striking Examples of Jig Work. Illustrated description of interesting features in this shop at Bridgeport, Conn., its fittings, methods, etc. 2800 w. Mach, N. Y.—May, 1900. No. 33929.

Messrs. Ferranti's Hollinwood Works. Illustrates and describes some of the principal products of these works. 3300 w. Elec Eng, Lond—May 18, 1900. Serial. 1st part. No. 34476 A.

Shops of Wells Brothers, Greenfield, Mass. Interesting views and brief description of an establishment for the manufacture of taps and dies and screw-cutting appliances. 500 w. Am Mach—May 3, 1900. No. 33962.

The Works of Sir William Arrol & Co., Limited. Illustrated detailed description of one of the most notable bridge-building establishments of Glasgow. 2200 w. Engr, Lond—May 18, 1900. Serial. 1st part. No. 34467 A.

Speed Cones.

On the Design of Speed Cones: A New Formula. James J. Guest. Explanation of method. 700 w. Trans Am Soc of Mech Engs, No. 861—May, 1900. No. 34200 C.

Tools.

Designing Jigs and Fixtures. Edwin C. Thurston. Helpful suggestions for shop work. 1900 w. Mach, N. Y.—May, 1900. No. 33930.

Turret Head.

Origin of the Turret, or Revolving Head. E. G. Parkhurst. Historical review of inventions belonging to this class, illustrating and describing some of them. 2200 w. Am Mach—May 24, 1900. No. 34398.

Works Management.

Commercial Organization of the Machine Shop. Hugo Diemer. Systems for the classification of shop orders, working plans for securing speed, accuracy and economy in the progress of work through the shop. 2700 w. The Engineering Magazine—June, 1900. No. 34496 B.

Workshop Administration. David Cowan. Considers the administration a branch of the productive art, and makes special reference to tracing work and ascertaining detailed costs and profits. 6400 w. Trans Inst of Engs & Shipbuilders in Scotland—April, 1900. No. 34327 D.

POWER AND TRANSMISSION.

Blast-Furnace Gas.

On the Production and Use of Power from Blast-Furnace Gas. Horace Allen. Read before the So. Staffordshire Ir. and Steel Inst. States the conditions affecting the combustion, the difficulties attending the economical application of blast-furnace gas for raising steam, reviewing the objections made to gas engines in iron works, etc. 2500 w. Ir & Coal Trds Rev—April 27, 1900. No. 34059 A.

See also Blowing Engine, under Special Motors, below.

Cableway.

The Log Cableway at Richtersweiler, Switzerland (Die Richtersweiler Holzriese). Prof. W. Ritter. An illustrated description of an aerial wire cableway 2,100 yards long, for transporting logs weighing 2 tons. Serial. 1st part. 1800 w. Schweiz Bauzeitung—May 12, 1900. No. 34165 B.

Flywheel Accidents.

Flywheel Accidents. Read by Prof. Sharp before the Civ. and Mech. Engs.' Soc. Considers the causes of bursting, and gives illustrated description of various designs, including one by the writer. 2200 w. Ir & Coal Trds Rev—May 4, 1900. No. 34262 A.

Furnace Charging.

Furnace Charging Apparatus. Illustrates and describes an invention to be adopted by the National Tube Works to carry skelp or plates to be heated. 2200 w. Am Mfr & Ir Wld—May 3, 1900. No. 33988.

Mechanical Transport.

Temperley Transporting Plant at Sfax.

Illustrates and describes an interesting plant recently constructed for handling phosphates. 1400 w. Engng—May 11, 1900. Serial. 1st part. No. 34356 A.

Office Building.

Power Equipment of the Tall Office Building. R. P. Bolton. A discussion of the economies of a new class of small central stations, in the light of the latest storage battery practice, and of the demands of lighting and elevator service. 3500 w. The Engineering Magazine—June, 1900. No. 34494 B.

Power Development.

The Big Blast and Power Development of the Pike's Peak Power Co. Illustrated description of a large blast to secure granite to build a dam, with account of the work. 900 w. Eng News—May 17, 1900. No. 34308.

Pneumatic Dispatch.

London's Lost Tunnel. An illustrated account of this tunnel, constructed to carry the mails and postal parcels between the two terminal points by means of pneumatic pressure. 2500 w. Compressed Air—May, 1900. No. 34292.

Transmission.

Power Transmission by Gas and Electricity. Alton D. Adams. Discusses the efficiencies of steam and gas engines for generating electric power; the relative losses and expenses in transmitting power for long distances by electric wires and by gas in pipes, and the commercial limits to the practicability of each. 3200 w. Mines & Min—May, 1900. No. 34010 C.

Vibromotor.

The Vibromotor Automatically Balanced Screening Machinery. Illustrates and describes an apparatus for utilizing the vibrations set up in a reciprocating or gyratory piece of machinery. 800 w. Col Guard—May 11, 1900. No. 34372 A.

SPECIAL MOTORS.

Blowing Engine.

Communication on the Test of the First Blast-Furnace Gas Blowing-Engine (Mittheilungen über die Versuche mit der Ersten Hochofengas-Gebläsemaschine). Preliminary account of a successful test of the large Delamare-Cockerill blowing-engine at Seraing, Belgium. 500 w. Stahl und Eisen—April 15, 1900. No. 34125 D.

On a Blowing Engine Worked by Blast Furnace Gas. Adolphe Greiner. Read before the Iron and Steel Inst. Abstract of the results obtained at the Cockerill Works with the first blowing engine worked by blast-furnace gas ever employed in any iron works. 1200 w. Engng—May 11, 1900. No. 34359 A.

Engine Tests.

Tests of a 10 H. P. Otto Gasoline Engine. H. A. Soverhill. Tests made to determine the gasoline consumption per brake and indicated horse-power per hour, the mechanical efficiency of the engine, and also a heat balance. Ill. 1000 w. Tech, No. 14—1899-1900. No. 34390 D.

Gas Engines.

The Use of Blast Furnace Gases in Gas Engines at Works in Silesia (Verwendung der Hochofengase zum Betriebe von Gasmaschinen auf der Dormersmarckhütte und Friedenshütte). Papers read before the *Eisenhütte Oberschlesien*, giving the results of practical operation. 3000 w. Stahl und Eisen—April 15, 1900. No. 34124 D.

Gas Turbine.

An Investigation of the Gas Turbine. W. O. Amsler. Mathematical and experimental investigation of the actions going on in the explosion chamber. 5000 w. Sib Jour of Engng—May, 1900. No. 34487 C.

Ignition.

The Gas-Engine Hot-Tube as an Ignition Timing Device. William T. Magruder. A record of data and results of a series of gas-engine tests at the Ohio State Univ. 4000 w. Trans Am Soc of Mech Engs, No. 859—May, 1900. No. 34099 C.

STEAM ENGINEERING.

Auxiliaries.

Steam Plant Auxiliaries. P. C. Percy. Discusses feed pumps of various types. 1900 w. Am Elect'n—June, 1900. No. 34454.

Balancing.

On Balancing of Steam Engines. Otto Schlick. Read before the Inst. of Naval Archts. Discusses the method of finding the balance for a four-crank engine. 2200 w. Engng—April 20, 1900. No. 33945 A.

Binary Vapor Engine.

The Behrend-Zimmermann Binary-Vapor Engine. A description of an engine invented by G. Behrend and Dr. Zimmermann, and improved by Prof. Josse, in which the heat of exhaust steam evaporates sulphurous acid and the cold vapor thus generated does work in an auxiliary cylinder amounting to half the power developed in the steam cylinders. 1100 w. Eng Rec—May 5, 1900. No. 33996.

The Behrend-Zimmermann Cold Vapour Engine (Die Behrend-Zimmermannsche Kaltdampfmaschine). An account of Prof. E. Josse's experiments with an engine in which the heat of the exhaust steam is utilized in evaporating another liquid having a lower boiling point than water. 1400 w. Stahl und Eisen—April 15, 1900. No. 34129 D.

Boilers.

The Manipulation of Boiler Plates. Substance of replies in response to a circular, giving quite a complete account of the handling of plates. 1800 w. Ry Age—May 25, 1900. No. 34440.

See also Electrical Engineering, Generating Stations.

Coal Handling.

See Electrical Engineering, Generating Plant.

Cylinder Proportions.

Cylinder Proportions for Compound and Triple-Expansion Engines. Bert. C. Ball. Presented at Junior meeting, March 6, 1900. A discussion of this question, and of the drawing of indicator diagrams by these engines. 4500 w. Trans Am Soc of Mech Engs, No. 857—May, 1900. No. 34097 C.

Engine Breakage.

Some Strange Breakages. John E. Sweet. Illustrated description of interesting examples. 800 w. Am Mach—May 17, 1900. No. 34307.

Engines.

See Electrical Engineering, Generating Stations.

Explosion.

A Landslide Explodes a Boiler. Illustrates and describes the circumstances under which an explosion occurs at Rosendale, N. Y. 1100 w. Locomotive—March, 1900. No. 34486.

Feed Water.

The Purification of Boiler Feed Water. An explanation by Albert A. Cary in reply to a correspondent, regarding the fitting of the tubes on the water side in the boilers. 4000 w. Power—May, 1900. No. 33960.

Water-Softening Plant at the Lorain Steel Company's Blast Furnaces. N. O. Goldsmith. Illustrates and describes the plant and the conditions necessary for accurate and uniform treatment, and other points of importance. 2400 w. Trans Am Soc of Mech Engs, No. 863—May, 1900. No. 34202 C.

Boiler Feed-Water Treatment. W. H. Edgar. Topical discussion at meeting of the Western Ry. Club. 3500 w. Ry & Engng Rev—April 28, 1900. No. 33932.

Feed-Water Heaters.

Live-Steam Feed-Water Heaters. W. F. Durand. Considers the relation of the live-steam heater to the heat losses, concluding that their use is favorable to economy. 2800 w. Am Elect'n—May, 1900. No. 33938.

Governors.

Shaft Governors. J. C. Cornock. Illustrates and describes various forms, and explains the method of control in part first. 3000 w. Prac Engr—May 4, 1900. Serial. 1st part. No. 34271 A.

Liquid Fuel.

The Utilization of Liquid Fuels (Utilisation des Combustibles Liquides). H. Guérin. A general review of an article by H. Tweddle, in the *Engineering and Mining Journal*, with original matter. Illustrations and tables. Serial. 1st part. 3500 w. Génie Civil—May 12, 1900. No. 34187 D.

Marine Engines.

On the Uniformity of Turning Moments of Marine Engines. Dr. Lorenz. Read before the Inst. of Naval Archts. Arguing that the balance of the reciprocating masses agrees well with the conditions for the most uniform possible diagram of turning moments, and is necessary for attaining a good uniformity of the angular velocity of the crank shaft. 1500 w. Engng—April 20, 1900. No. 33944 A.

Pumping-Engine.

A Test of a Fifteen-Million High-Duty Pumping Engine at Grand Rapids, Mich. M. E. Cooley and F. C. Wagner, and J. R. Allen. Describes the boiler, engine, pumps, preparations for tests, apparatus used, etc., the tests and results. Ill. 20000 w. Trans Am Soc of Mech Engs, No. 855—May, 1900. No. 34095 C.

Pumping-Engine Test with Superheated Steam. E. H. Foster. Describes a duty test of a small pumping engine at the city water-works in St. Albans, England, giving results. 1000 w. Trans Am Soc of Mech Engs, No. 865—May, 1900. No. 34204 C.

Tests of the Snow Pumping Engine at the Riverside Station of the Indianapolis Water Company. W. F. M. Goss. Illustrated description of the engine, with account of the test and results. 6500 w. Trans Am Soc of Mech Engs, No. 862—May, 1900. No. 34201 C.

Reheaters.

Reheaters in Multiple Cylinder Engines. R. H. Thurston. A review of what is already known of this subject, and conclusions. 5200 w. Trans Am Soc of Mech Engs, No. 856—May, 1900. No. 34096 C.

Scale.

A Simple and Successful Scale Prevention Method. Illustrates and describes the system of J. G. Talmage, which is pronounced to be successful when properly operated. 1600 w. Am Engr & R R Jour—May, 1900. No. 33953 C.

Speed.

Speed Regulation of Engines. G. J. Wells. Read before the Brit. Assn. of Draughtsmen. Part first investigates the

causes of variations in the mean effective pressure, and illustrates by taking a case from practice. Ill. 1800 w. Prac Engr—April 27, 1900. Serial. 1st part. No. 34052 A.

Steam Engines.

How the Common Syringe Became the Steam Engine. Robert L. Galloway. Traces the mechanical evolution. 2200 w. Col Guard—April 20, 1900. Serial. 1st part. No. 33913 A.

Steam Turbine.

Westinghouse-Parsons Steam Turbine Plant. Burcham Harding. Illustrated description of steam turbine plants now in use in American works, with notes on their efficiency in regular service. 3500 w. Eng Rec—May 5, 1900. No. 33998.

The Efficiency of the Direct-Coupled Steam Turbine. Ed. C. de Segundo. On the achievement, from the point of view of relative efficiency, of the improved steam turbine of the Westinghouse Co. 600 w. Elec Rev, Lond—April 27, 1900. No. 34055 A.

Stoking.

See Electrical Engineering. Generating Stations.

Tests.

The Rating of Steam Engines by Their Steam Consumption (Die Beurteilung der Dampfmaschine hinsichtlich ihres Dampfverbrauches). E. Meyer. Review and explanation of the rules recently adopted by the *Verein Deutscher Ingenieure*, etc.; and the full report of the Institution of Civil Engineers' Committee on Rules for Determining the Utilization of Heat in Steam Engines. Serial. 1st part. 6000 w. Zeitschr d Ver Deutscher Ing—April 28, 1900. No. 34106 D.

Standard Rules for Testing Steam Boilers and Engines (Normen für Leistungsversuche au Dampfkesseln und Dampfmaschinen). Specifications adopted by the *Verein Deutscher Ingenieure* and the *Verein Deutscher Maschinenbauanstalten*, and under consideration by the International Association of Steam Boiler Inspectors. 3000 w. Zeitschr d Ver Deutscher Ing—April 7, 1900. No. 34105 D.

MISCELLANY.

Aeronautics.

Count von Zeppelin's Air-Ship. Illustrated description, and discussion of this large dirigible air ship. 1000 w. Sci Am—May 26, 1900. No. 34403.

Armaments.

Machine Guns of Calibre. An explanation and discussion of armaments used in the South African war. 2300 w. Engr, Lond—May 11, 1900. No. 34368 A.

Armored Trains.

Armored Traction Trains for South Africa. Information concerning these trains, and their usefulness, reporting a successful trial run. 2300 w. Engng—May 18, 1900. No. 34466 A.

Brick Manufacture.

The Roller-Pallet System for the Manufacture of Bricks. Clemens Catesby Jones. Gives a brief account of prevailing industrial conditions and practice, describing the best modern system of drying, and presenting a mechanical process and its advantages. 4200 w. Trans Am Inst of Min Engs—Feb., 1900. No. 34035 D.

Disappearing Carriages.

Disappearing Gun Carriages in the United States. G. H. Powell. A description, by the Secretary of the Board of Ordnance, of the mountings which distinguish the U. S. coast defences from those of Europe. 1800 w. The Engineering Magazine—June, 1900. No. 34489 B.

Eccentric Loading.

Cases of Eccentric Loading. G. A. Goodenough. Discusses cases arising in practice, investigating the stresses. 3500 w. Tech, No. 14—1899-1900. No. 34383 D.

Export Trade.

The Follies of Some American Exporters. By a Continental Salesman. An arraignment of the fatuous methods of some would-be sellers in European markets, on a contrasting exposition of the careful efforts of German machinery makers. 3500 w. The Engineering Magazine—June, 1900. No. 34493 B.

Fuel.

Liquid Fuel in Europe. On the growing use, and the increased production. 600 w. U. S. Cons Repts, No. 731—May 16, 1900. No. 34273 D.

German Patents.

Decision of the Imperial Court on the Invalidity of Patents on Inventions Which Have Been the Subject of an Earlier Patent (Entscheidung des Reichsgerichts über Nichtigkeit von Patenten auf Grund des Sec. 10 Abs. 2 des Patentgesetzes). Full text of the decision, declaring void patents on inventions which have been covered by earlier patents, even though the earlier patent has expired. 4500 w. Glaser's Annalen—April 1, 1900. No. 34101 D.

Germany.

Report on the Economic Position of the German Empire in 1900 by Mr. Gastrell, Commercial Attaché to Her Majesty's Embassy at Berlin. Considers Germany's important position, development of trade, maritime interests, present commercial policy, finances, expenditure of army and navy, with many tables for comparison.

10800 w. Brit Dip & Cons Repts, No. 2400—April, 1900. No. 34215 D.

Gun.

The Genesis of the Magazine Shoulder Gun. E. G. Parkhurst. Illustrated detailed description and history of the John Cookson gun, made in 1586. 1600 w. Am Mach—May 17, 1900. No. 34304.

International Congress.

International Congresses at the Paris Exposition in 1900 (Internationale Congresse gelegentlich der Weltausstellung zu Paris, 1900). A list of the various congresses, with dates and addresses of the respective presidents and secretaries. 2000 w. Glaser's Annalen—April 15, 1900. No. 34120 D.

Metric System.

Progress of the Metric System in the United States. Abstract of the report of the committee on the metric system, presented at the Chicago meeting of the Am. Ry. Assn., showing its use to be confined to concerns which export to metric countries. 1300 w. Eng News—May 10, 1900. No. 34229.

Paris Exposition.

The Paris Exposition as a Mechanical Achievement. Edmund Mitchell. A review of the system, organization and plan of this stupendous undertaking, and a survey of the general result. 3600 w. The Engineering Magazine—June, 1900. No. 34490 B.

The Paris Exposition (Die Pariser Weltausstellung). A general illustrated description, with particulars of some engineering features. Two articles. 4500 w. 1 plate. Stahl und Eisen—April 15, May 1, 1900. No. 34123 each D.

The United States Sections at the Paris Exposition (Exposition Universelle de 1900. La Participation des Etats-Unis). Aym. de Marolles. A general account of the space occupied by, and the officials of the United States. 2400 w. Revue Technique—April 25, 1900. No. 34480 D.

Smoke.

Smoke Abatement. E. A. Brayley Hodgetts. A discussion of the smoke question and the remedy. 2000 w. Jour San Inst—April, 1900. No. 34239 E.

The Smoke Nuisance and the Medical Officer of Health. Joseph Priestley. Reviews acts dealing with smoke in Great Britain. 2000 w. Jour San Inst—April, 1900. No. 34240 E.

Weighbridges.

Large Weighbridges. Illustrated description of a 110-ton railway weighbridge made for a large marine engineering firm, and a large hot iron plate weighing machine. 1400 w. Engr, Lond—May 4, 1900. No. 34257 A.

MINING AND METALLURGY

COAL AND COKE.

Accidents.

Prevention of Accidents in Connection with Mine Passes. Victor Watteyne. From a communication to the *Annales des Mines de Belgique*. Part first considers accidents that occurred while the pass was being cleared of obstruction from below and from above. Ill. 1800 w. Col Guard—May 11, 1900. Serial. 1st part. No. 34375 A.

Caging.

Mechanical Caging at the Commentry Colliery. Illustrated description of the arrangement. 1100 w. Col Guard—May 11, 1900. No. 34378 A.

China.

The Coal Fields Around Tsê Chou, Shansi, China. Noah Fields Drake. Information concerning this famous region, the manner of working and transporting the coal, and matters of related interest. Ill. 3500 w. Trans Am Inst of Min Engs—Feb., 1900. No. 34029 D.

Coal Cells.

Coal Cell Trade. George Johnson. An explanation of the manner of working coal cells provided for retail sale of coal. 1000 w. Col Guard—May 11, 1900. No. 34374 A.

Coal Supply.

The Coal Famine and the Public. From the London *Times*. Discusses the causes of the recent scarcity and high cost of fuel all over the world. 4000 w. Jour Gas Lgt—April 24, 1900. No. 33947 A.

Coal Working.

Coal Mining by Mechanical Appliances. James Warne Chenhall. Describes the working of the Cambria Mining Co.'s Plant at Cambria, Wyoming, U. S. A. 3500 w. Col Guard—May 11, 1900. No. 34376 A.

Working Twin Seams of Coal. W. S. Gresley. Descriptions of methods which have come within the writer's observation. Ill. 3000 w. Eng & Min Jour—May 12, 1900. Serial. 1st part. No. 34224.

Electric Plant.

New Electric Plant at the Blanzy Colliery. M. Goichot. From a communica-

tion to the Société de l'Industrie Minérale. Illustrated description of the plant and the appliances for utilizing the current for motive power. 3300 w. Col Guard—April 20, 1900. No. 33914 A.

Explosion.

The Mine Explosion at Scofield, Utah. An account of one of the most serious disasters of modern times, causing the loss of over 250 lives. 1500 w. Eng & Min Jour—May 12, 1900. No. 34222.

Explosives.

Use of Safety Explosives in Fiery Mines. M. L. Aguillon. From a report on behalf of the French Firedamp Commission. Considers the regulations to which safety explosives are subject in France, and the need of having the composition printed on all the cartridges used in fiery mines. 3500 w. Col Guard—May 4, 1900. No. 34265 A.

Faults.

A Peculiar Fault and a Problem in Coal Mining. Arthur Lakes. An illustrated description of a coal seam thrown a half mile horizontally out of position. 1000 w. Mines & Min—May, 1900. No. 34004 C.

Gob-Fires.

The Standard Theory of Gob-Fires. H. W. Halbaum. A statement of what mining engineers believe in regard to such phenomena as gob-fires. Attributes them to spontaneous combustion, explaining the manner, and discussing the prevention and extinction. 6700 w. Col Guard—April 27, 1900. No. 34067 A.

Haulage.

See under Mining, below.

Natal.

The Coal Industry in Natal. Reviews the history of the industry, and considers the future prospects most promising. 1200 w. Col Guard—April 20, 1900. No. 33916 A.

New Plant.

New Plant at Broomhill Colliery. John E. O'Keefe. From the *Journal of the British Society of Mining Students.* Brief description. 800 w. Col Guard—May 18, 1900. No. 34474 A.

Prospectus.

Russia's Lack of Coal (Crise Houillère spectus. George Johnson. Considers points which occur in negotiations for the acquirement of mining property, and in the preparation of the prospectus when the business takes the form of a limited liability company. 2000 w. Col Guard—April 20, 1900. No. 33917 A.

Russia.

Russia's Lack of Coal (Crise Houillére en Russie). An account of the scarcity of coal in Russia, the lowering of the customs duties, discussion of ways and means to increase the domestic supply and tables showing imports in recent years. 1000 w. Moniteur Ind—April 14, 1900. No. 34194 E.

Sidings.

Colliery Sidings and Agreements. George Johnson. A discussion of the chief factors to be considered. 2200 w. Col Guard—May 18, 1900. No. 34473 A.

Under Sea.

The Working of Coal Mines Under Sea. Thomas Bell. Read before the Manchester Geol. Soc. Concerning the depth and extent to which the coal mines have been worked under the sea off the coast of Durham and Northampton; also under the permian feeder of water, in the county Durham. 2800 w. Ir & Coal Trds Rev, and Col Guard—May 4, 1900. Serial. 1st part. No. 34261 A.

Western Coal.

The Geological Position of Trans-Mississippian Coal. Charles R. Keyes. Information obtained during recent investigations concerning the stratigraphical position of seams, and other features. 1900 w. Eng & Min Jour—May 5, 1900. No. 34080.

COPPER.

Arizona.

The Ray Copper Mines, Arizona. Alexander Hill. An account of the location and development of these deposits, with plan of workings and percentage of copper found in assays taken at different points. 1900 w. Eng & Min Jour—May 19, 1900. No. 34341.

Assaying.

See Gold and Silver, below.

Butte.

The Mines of Butte. Arthur Lakes. A description of the Gagnon mine, the Original mine and the Stewart mine; the ores as they are found and the formations of the veins; the plants for hoisting and handling them and for preparing the mine timber. Ill. 2500 w. Mines & Min—May, 1900. No. 34014 C.

Cuba.

El Cobre Mines, Cuba. Illustrations and brief account of these copper mines, located 12 miles west of Santiago. 450 w. Eng & Min Jour—May 19, 1900. No. 34339.

GOLD AND SILVER.

Assaying.

The Assay of Copper-Materials for Gold and Silver. L. D. Godshall. Brief review of two methods used and description of a method recommended by the writer. 900 w. Trans Am Inst of Min Engs—Feb., 1900. No. 34033 D.

Australia.

The Northern Territory. F. D. Holland. Illustrated description of the auriferous reefs of the Northern Territory of South Australia. 1200 w. Aust Min Stand—April 5, 1900. Serial. 1st part. No. 34209 B.

British Columbia.

The Atlin Gold Fields of British Columbia. J. H. Brownlee. Illustrated description of the conditions and prospects. 2000 w. Min & Sci Pr—May 19, 1900. No. 34402.

The Atlin District. William Baillie. An illustrated account of the discovery, giving the results of work done, and the prospects for the future. 3800 w. B. C. Min Rec—May, 1900. No. 34275 C.

Cape Nome.

Some Notes on the Nome Gold Region of Alaska. F. C. Schrader and Alfred H. Brooks. Describes the region, the deposits, the difficulties to be met, etc. Map. 4000 w. Trans Am Inst of Min Engs—Feb., 1900. No. 34031 D.

The Gold Deposits of Cape Nome. Charles G. Yale. Information concerning those beach deposits, and their probable origin, means of working, etc. 1700 w. Sci Am Sup—May 12, 1900. No. 34213.

Gold Deposits and Mining Methods at Cape Nome. Information concerning the location, devices or power machines used, etc. Ill. 1400 w. Sci Am—May 19, 1900. No. 34295.

Concentration.

Small Mine Concentration. S. I. Hallett. Sketches of two mills, one having a capacity of from 12 to 25 tons in 24 hours, the other from 35 to 50 tons, with description. 2200 w. Min & Sci Pr—May 5, 1900. No. 34205.

Cyanide Plant.

Cyanide Plant at the Octave Mine, Weaver, Ariz. Illustrated description of a MacArthur-Forest cyanide plant for treating tailings, showing how simple a plant can be when no protection from the weather is necessary. 700 w. Min & Sci Pr—April 28, 1900. No. 33984.

Dikes.

A Peculiar Clastic Dike near Ouray, Col., and Its Associated Deposit of Silver Ore. F. L. Ransome. Illustrated description of a deposit of unusual character. 1600 w. Trans Am Inst of Min Engs—Feb., 1900. No. 34036 D.

Ecuador.

Notes on the Gold Mines of Zaruma, Ecuador. J. Ralph Finlay. A general description of the mines and methods of mining, lumbering, etc. Ill. 3000 w. Trans Am Inst of Min Engs—April, 1900. No. 34030 D.

Extraction.

Gold Extraction Processes and New Solvents. J. Ohly. Part first describes the process of M. de Rigaud, and the substitution of bromine for chlorine in the chlorination process. 1400 w. Min Rept—April 26, 1900. Serial. 1st part. No. 33948.

Mexico.

Mining and Smelting in the State of Durango, Mexico. H. Van F. Furman. An illustrated description of the mines and some peculiar problems met with in smelting. 3000 w. Mines & Min—May, 1900. No. 34002 C.

Ores.

An Examination of the Ores of the Republic Gold Mine, Washington. T. M. Chatard and Cabell Whitehead. A report of investigations, showing the importance of thorough chemical examination of such gold-ores as do not readily yield their values. 1500 w. Trans Am Inst of Min Engs—Feb., 1900. No. 34034 D.

Philippines.

Gold in the Philippines. William Gilbert Irwin. Brief account of such researches as have been made in the Island of Luzon, and the promising outlook. 800 w. Eng & Min Jour—May 19, 1900. No. 34340.

Smelters.

Smelters and Reduction Works of the Northwest. Arthur Lakes. Facts in regard to the location and capacities of the various works. 2000 w. Mines & Min—May, 1900. No. 34013 C.

Stamp Milling.

Water and Fuel Economy in Stamp Milling. A. W. Warwick. Facts and figures concerning the minimum amount of water that will supply a 10-stamp mill. 1200 w. Eng & Min Jour—May 5, 1900. No. 34081.

Washington.

The Lone-Pine-Surprise-Consolidated Mines, Republic, Washington. M. H. Joseph. An illustrated account of these mines and the value of the ore already blocked out. 2700 w. Eng & Min Jour—May 26, 1900. No. 34438.

IRON AND STEEL.

Annealing Furnace.

Steel Plate Annealing Furnace (Flusseisenblech-Glühofen. Hen. Wdowiszewski. Abstract of a Russian article by Director J. Q. Ravner of the Kulebaki iron works near Nijni Novgorod, giving an illustrated account of an annealing furnace there. 800 w. Stahl und Eisen—May 1, 1900. No. 34131 D.

Armor.

Manufacture of Guns and Armor at the Bethlehem Steel Works. An illustrated description of the open hearth process. 2000 w. Sci Am—May 19, 1900. No. 34294.

Blowing Engines.

See Mechanical Engineering, Special Motors.

British Columbia.

Iron Ore Deposits of Vancouver and Texada Islands. William M. Brewer. An account of rich deposits which have received little attention. 1200 w. Eng & Min Jour—May 5, 1900. No. 34079.

Canada.

Canada: Its Iron Resources and Possibilities. Walter R. Nursey. Information concerning the deposits in Canada, their richness and extent. 3800 w. Ir & Coal Trds Rev—April 27, 1900. No. 34058 A.

Concentrating.

Concentrating Lake Superior Ore. L. M. Hardenburgh. Paper read at the Lake Superior Mining Inst. on the treatment of lean Pewabic ore. 1000 w. Am Mfr & Ir Wld—May 10, 1900. No. 34289.

Georgia Iron Ores.

Geological Relations of the Iron-Ores in the Cartersville District, Georgia. C. Willard Hayes. Illustrates and describes the stratigraphy and structure of this region and the ore deposits. 6000 w. Trans Am Inst of Min Engs—Feb., 1900. No. 34038 D.

German Statistics.

Statistics (Statistisches). Tables giving German exports and imports for January and February, 1899 and 1900; iron consumption, 1861-1899; and the production of mines and iron works in 1899. 1500 w. Stahl und Eisen—May 1, 1900. No. 34134 D.

Hot Blast.

The Equalization of the Varying Temperatures of Hot Blast. Lawrence F. Gjers and Joseph H. Harrison. Read before the Iron and Steel Inst. Illustrated description of apparatus which delivers the blast at an even mean temperature. 1300 w. Col Guard—May 11, 1900. No. 34373 A.

Liquid Fuel.

The Utilization of Liquid Fuels for Metallurgical Purposes in Russia (Verwendung von Flüssigem Brennstoff für Hüttenmännische Zwecke in Russland). J. Preiner. An illustrated account of methods of using naphtha in metallurgical furnaces. 2400 w. Stahl und Eisen—April 15, 1900. No. 34127 D.

Liquid Fuel in Russian Iron Works. J. Preiner, in *Stahl und Eisen*. Illustrates and describes the methods of burning the fuel, and some idea is given of the expense. Russian petroleum is described, and its extensive use reported. 3000 w. Col Guard—April 27, 1900. No. 34068 A.

Open Hearth.

The Open-Hearth Continuous Steel Process. Benjamin Talbot. Read before the Iron and Steel Inst. Describes this process as worked at the Pencoyd Steel Works, at Pencoyd, Pa., and a statement of the advantages. Discussion. 9000 w. Ir & Coal Trds Rev—May 11, 1900. No. 34379 A.

The Use of Fluid Metal in the Open-Hearth Furnace. James Riley. Read before the Iron and Steel Inst. A discussion of this process and its advantages, and the opinion that eventually this process will prevail. 4200 w. Engng—May 11, 1900. No. 34355 A.

A New Process for the Production of Basic Open-Hearth Steel from Pig and Ore. Ambrose Monell. A description of this process, also calling attention to other developments in metallurgy. 3500 w. Ir & Coal Trds Rev—May 11, 1900. No. 34380 A.

Pig Iron.

Pig Iron Breakers. T. E. G. Marley describes the machine at the works of the Whitehaven Hematite Iron & Steel Co., Ltd., and Enoch James the hydraulic machine used at the Dowlais Works. Ill. 2800 w. Col Guard—April 20, 1900. No. 33918 A.

Riddles.

Riddles Wrought in Iron and Steel. Paul Kreuzpointner. Considers some of the puzzling problems encountered, and the manifestations which are apparently the source of many of them. Discussion. Ill. 11400 w. Jour Fr Inst—May, 1900. No. 34092 D.

Slag.

The Utilization of Blast-Furnace Slag Cecil von Schwarz. Read before the Iron and Steel Inst. Briefly describes a method recently employed in Germany and Belgium for manufacturing cement out of slag, which has given the best results as to strength and reliability. 1700 w. Col Guard—May 11, 1900. No. 34377 A.

Specifications.

Standard Specifications for Steel and Iron. A set of specifications for steel for bridges, buildings, and ships, and for wrought iron; with an editorial discussion of the value of the work done by the Am. Sec. of the International Assn. for Testing Materials in preparing them. 2500 w. Eng Rec—May 19, 1900. No. 34329.

Standard Specifications for Materials. The first of a series of articles publishing

important tables and giving synopses of proposed specifications of the Am. Sec. of the International Assn. for Testing Materials. 2000 w. R R Gaz—May 11, 1900. No. 34233.

The Proposed American Standard Specifications for Steel. A review of these important specifications. 6500 w. Ir Age—May 17, 1900. No. 34285.

Sweden.

Sweden's Wealth in Iron Ore (Schwedens Eisenerzschätze). Abstract of an article in *Jernkontorets Annalen* by C. Nordenström, giving statistical information, with tables. 1500 w. Stahl und Eisen—May 1, 1900. Serial. 1st part. No. 34132 D.

Wire Mills.

New Trains of Rolls (Neue Walzstrassen). Edm. Weber. A description, with diagrams, of arrangements of rolls for the economical production of wire. 1500 w. Stahl und Eisen—April 15, 1900. No. 34126 D.

MINING.

China.

Present Situation of the Mining Industry in China. H. C. Hoover. Information relating to the regulations and concessions affecting the mining industry. 2000 w. Eng & Min Jour—May 26, 1900. No. 34439.

Dams.

See Civil Engineering, Hydraulic and Marine.

Deep Mining.

Deep Mining at the Utica Mine, Angels, California. J. H. Collier, Jr. Gives an outline of the general nature of the deposit and the difficulties of mining, shaft sinking, etc., with detailed explanation of the excavation of the ore. Ill. 6500 w. Trans Am Inst of Min Engs—Sept., 1900. No. 34039 D.

Electric Power.

Electricity Applied to Mining. Harold Bentham. Read before the Manchester Soc. of Jun. Elec. Engs. Considers the advantages and disadvantages of steam and electricity as motive power, and the lighting. Ill. 2100 w. Elec Engr, Lond—May 11, 1900. Serial. 1st part. No. 34360 A.

Electricity in Mining. R. B. Williamson. Considers the principles governing the calculation, construction, and operation of electrical installations, giving explanation of electrical units, circuits, resistances in series and multiple, electric wiring, etc. 3000 w. Mines & Min—May, 1900. Serial. 1st part. No. 34011 C.

The Electric Central Station for Power and Light at the Margarethe Mine at Sölde, Westphalia (Die Elektrische Centrale für Kraftübertragung und Beleuchtung auf der Zeche Margarethe bei Sölde i. Westf.). A short account of the plant, which furnishes power and light for the mine, and also for the surrounding district. 1000 w. Glückauf—May 5, 1900. No. 34153 B.

Electric Pumps.

Electrically Driven Mining Pumps (Elektrisch Betriebene Bergwerkspumpen). A well illustrated account of various electric pumps at mines in Germany and Austria. Two articles. 3000 w. Glückauf—April 28, May 5, 1900. No 34152 each B.

Electric Winches.

Electrically Driven Hauling Winches (Ueber Elektrisch Betriebene Förderhaspel). Wilhelm Müller. An illustrated account of some electric winches at mines in the Ruhr coal district, Westphalia. 3 plates. 6000 w. Glückauf—April 21, 1900. No. 34151 B.

Explosives.

British and American Explosives. A Comparison. Considers the legislative restrictions and the benefits in the United Kingdom, the names given, the profits, etc. 1200 w. Col Guard—April 27, 1900. No. 34066 A.

Fans.

Comparative Tests of a Rateau and a Guibal Fan. A report of tests under the same conditions, showing the superiority of the Rateau fan. 1000 w. Col Guard—May 4, 1900. No. 34267 A.

Haulage.

Electrical Winding and Haulage Machinery. W. Müller. Translated and abridged from *Glückauf*. Describes the electrical plants in use in the mines of the Ruhr coal district. Ill. 2800 w. Ir & Coal Tds Rev—May 18, 1900. Serial. 1st part. 34462 A.

Statistics of Rope Haulage in Shafts (Statistik der Schachtförderseile). Tables showing the life, efficiency, breakages, etc., of wire, hemp and other kinds of rope. 2000 w. Oesterr Zeitschr f Berg u Hüttenwesen—May 12, 1900. No. 34150 B.

Pit Ponies and Horse Haulage. F. Povey-Harper. Paper read before the British Soc. of Min. Students. Discusses the cost, care, etc. 1300 w. Ir & Coal Trds Rev—May 18, 1900. No. 34461 A.

Igniter.

Meinhard's Improved Igniter for Blasting Charges. From *Oesterreichische Zeitschrift für Berg und Hüttenwesen.* Illustrated description of the apparatus, with results of experiments. 800 w. Col Guard—April 20, 1900. No. 33915 A.

Indicators.

Recording Indicators for Firedamp and

the Velocity of Air Currents. P. Fuchs, in *Zeitschrift für Berg-, Hütten-, und Salinenwesen.* Illustrated description of the apparatus employed for securing the records by the photographic method. 1500 w. Col Guard—May 4, 1900. No. 34266 A.

Labor.

Eight Hour Shifts and the Minimum Wage in Mining (Ueber die Achtstundenschicht und den Minimallohn beim Bergbau). W. Jicinsky. A general discussion of the labor question in Austrian mines. 4400 w. Oesterr Zeitschr f Berg u Hüttenwesen—April 28, 1900. No. 34146 B.

Is It Advisable to Introduce Nine Hour Shifts at all Coal Mines (Ist es Rathsam, bei Sämmtlichen Kohlenbergbauen die Nuenstündige Schichtdauer Einzuführen)? Carl Balling. Discussion of the effect on production and prices, in Austro-Hungary. 3200 w. Oesterr Zeitschr f Berg u Hüttenwesen—April 14, 1900. No. 34145 B.

Mine Accidents.

The Want of Forethought.—The Causes of Mine Accidents. R. M. Haseltine. Read before the Ohio Inst. of Min. Engs. Describes peculiar accidents arising from conditions which have only recently existed in mines. 1500 w. Mines & Min—May, 1900. No. 34008 C.

Mine Engine.

An Old Mine Engine. K. Müller. *Oesterreichische Zeitschrift für Berg und Hüttenwesen.* Brief illustrated description of engine constructed in 1813 and used in Bohemia. 900 w. Col Guard—April 27, 1900. No. 34063 A.

Mining Law.

Abandonment of Leased Mines. Facts of several cases and the adjudications in the same in the United Kingdom. 4700 w. Col Guard—April 27, 1900. No. 34064 A.

Mining Methods.

Method of Mining at the Badger Mine, Commonwealth, Wis. O. C. Davidson. Read before the Lake Superior Mining Inst. Describes the methods used and the difficulties met. The maximum product attained in one month was 38,000 tons. 800 w. Mines & Min—May, 1900. No. 34007 C.

Sardinia.

Progress in Ore Preparation Processes in Sardinia (Fortschritte der Erzaufbereitung in Sardinien). Erminio Ferraris. Description of swinging sieves used in sorting ores. 1600 w. 1 plate. Oesterr Zeitschr f Berg u Hüttenwesen—May 5, 1900. No. 34147 B.

Shafts.

Sinking Shafts by Means of the Poetsch Freezing Method (Die Abteufung von Schächten mittels des Poetsch'schen Gefrierverfahrens). F. H. and Walter Poetsch. A long description of practical experience with this method of solidifying quicksand and other loose materials, so that shafts can be sunk through them. Four articles. 8000 w. 1 plate. Oesterr Zeitschr f Berg u Hüttenwesen—April 14, 21, 28, May 5, 1900. No. 34144 each B.

Simultaneously Sinking, Lining, and Fitting a Shaft with Guides. M. Bouteille. From a communication to the Société de l'Industrie Minérale. Illustrated detailed description of interesting work. 4200 w. Col Guard—April 27, 1900. No. 34065 A.

Signals.

Electric Signals at West Vulcan. A. W. Thompson. Read before the Lake Superior Mining Inst. Considers peculiarities in their construction and the experiences which showed their necessity. 1500 w. Mines & Min—May, 1900. No. 34005 C.

MISCELLANY.

Arsenic.

The British Arsenic Industry. Some facts relating to the methods used in the manufacture of arsenic from the ore, and the effect upon the workmen. 2500 w. Engng—May 4, 1900. No. 34248 A.

Austro-Hungary.

Austro-Hungarian Foreign Trade in Mining and Metallurgical Products for 1899 (Der Auswärtige Handel des Oesterreichisch-Ungarischen Zollgebietes in Waaren der Montanindustrie im Jahre 1899). Dr. Moritz Caspaar. A general account, with statistical tables. Two articles. 3500 w. Oesterr Zeitschr f Berg u Hüttenwesen—May 5, 12, 1900. No. 34148 each B.

Borax.

Borax—Old and New Methods of Production. Illustrated account of the deposits in the United States and the methods used. 1000 w. Sci Am—May 26, 1900. No. 34404.

German Statistics.

Comparative Statistics of the German Patent Office for 1899 (Vergleischende Statistik des Kaiserlichen Patentamtes für das Jahr 1899). Tables giving general statistics, with some details of the mining and metallurgical classes. 700 w. Stahl und Eisen—May 1, 1900. No. 34133 D.

Manganese.

The Manganese Ores of Brazil. Herbert Kilburn Scott. Read before the Iron and Steel Inst. Describes the position and geology of the deposits, and gives a brief outline of the history of manganese mining, and other information of interest. 5700 w. Col Guard—May 18, 1900. No. 34472 A.

Nickel.

Some Novelties in Nickel Metallurgy (Ueber Einige Neuerungen in der Metallurgie des Nickels). Prof. Ed. Donath and B. M. Margosches. A long article on nickel ores and their metallurgy. Serial. 1st part. 1800 w. Oesterr Zeitschr f Berg u Hüttenwesen—May 12, 1900. No. 34149 B.

Petroleum.

Prospecting for Petroleum in California. A. S. Cooper. Abstract from "Bulletin No. 16," California State Mining Bureau. Directions for prospectors, indications of the presence, tests, etc. 1200 w. Eng & Min Jour—May 12, 1900. No. 34223.

Salt.

Salt Mines of Avery's Island, Louisiana. Henry Romeyn. A description of the works and the interesting geological formation. 2500 w. Mines & Min—May, 1900. No. 34003 C.

The Salt Wells of Szchuan, China. W. M. Upcraft. Illustrated description of the peculiar methods of an important industry. 700 w. Eng & Min Jour—May 5, 1900. No. 34078.

Smelting.

The Smelting of Dubuque Ores. H. Foster Bain. History of the industry, the methods in use, and some observations on making spelter at Dubuque. 1700 w. Mines & Min—May, 1900. No. 34015 C.

Tin.

Blue Tier Tin Mining (T.). H. Grant. Information concerning the Anchor Mine. 1300 w. Aust Min Stand—March 29, 1900. No. 34207 B.

The Planet Tin Mines. Information concerning this Australian source of supl. 900 w. Aust Min Stand—April 5, 1900. No. 34208 B.

Yosemite.

Glacial Erosion and the Origin of the Yosemite Valley. William P. Blake. Considers the mining action of glaciers, the enormous glaciation in California, the origin of the Yosemite, and sub-glacial erosion generally. Ill. 4200 w. Trans Am Inst of Min Engs—Sept., 1899. No. 34037 D.

Zinc.

The Joplin Zinc District. F. Lynwood Garrison. Regarding its location, the ores, and the formations in which they occur; the methods of mining and marketing. 2600 w. Mines & Min—May, 1900. No. 34012 C.

RAILWAY AFFAIRS

CONDUCTING TRANSPORTATION.

Accident.

The Collision at Park Tunnel, Philadelphia. Facts concerning an accident on the B. & O., at Philadelphia, May 11, followed by an explosion of oil cars that blocked the tunnel for three days. 800 w. R R Gaz—May 25, 1900. No. 34417.

Freight Trains.

Handling Long Freight Trains on Mountain Grades. From a committee report presented at the Jacksonville meeting of the Assn. of Ry. Air Brake Men. 1800 w. Ry Mas Mech—May, 1900. No. 34302.

New South Wales.

Railway Practice in N. S. W. H. B. Howe. Presidential address to the Engng. Assn. of N. S. W. Part first gives information relating to the engines used. 1800 w. Aust Min Stand—March 29, 1900. Serial. 1st part. No. 34206 B.

Safety Appliances.

Are Present Methods of Train Protection Adequate? C. E. Davis. Brief paper of general character followed by discussion. Ill. 12500 w. Jour W Soc of Engs—April, 1900. No. 33921 D.

MOTIVE POWER AND EQUIPMENT.

Air Brakes.

Lubricating Air Brake Parts. From a report presented at the Jacksonville meeting of the Assn. of Ry Air Brake Men. 1800 w. Ry Mas Mech—May, 1900. No. 34303.

Cars.

A Convertible Box and Hopper Car. Illustrates and describes a car designed by W. T. Manning, adapted to various classes of freight ordinarily transported in cars of the two classes. 1000 w. Ry Age—May 25, 1900. No. 34441.

A Roadbed Trimming Car. Illustrated description of the general features of a car used on the Boston & Maine R. R. for a variety of purposes. 1000 w. Ry Age—May 18, 1900. No. 34346.

Classification and Numbering of Passenger and Freight Equipment. J. A. Gohen. Calls attention to the need of improvement, with suggestions. 1500 w. St. Louis Ry Club—May 11, 1900. No. 34445.

New Observation Buffet Cars for the Northern Pacific. Brief illustrated description of new cars to run between St. Paul and the Pacific coast. 300 w. Ry Age—April 27, 1900. No. 33927.

Coal Cars.

80,000 and 85,000-Pound Coal Cars. Illustrates and describes two new designs of wooden cars in use on the Buffalo, Rochester & Pittsburg Ry. They are

known as the "shovel car" and the "dock car." 600 w. Am Engr & R R Jour—May, 1900. No. 33949 C.

Coke Car.

A Pressed Steel Coke Car. Illustrations and brief description of a car for the Chicago, Lake Shore & Eastern Ry. 250 w. R R Gaz—May 11, 1900. No. 34234.

Couplings.

Automatic Railway Couplings. Describes the first English train fitted throughout with automatic couplings, and the trial made, calling attention to interesting improvements. 1500 w. Engng—April 27, 1900. No. 34061 A.

Draft Gear.

The Westinghouse Friction Draft Gear. Illustrated description of this device and its operation. 1800 w. Am Engr & R R Jour—May, 1900. No. 33955 C.

Electric Power.

See Electrical Engineering, Power Applications, and Street and Electric Tramways.

Feed Water.

See Mechanical Engineering, Steam.

Flanges.

Prevention of Wear of Driving Wheel Flanges. Describes the arrangements adopted by different roads for overcoming this trouble, especially describing the practice on the D., L. & W. R. R., which has been successful in stopping the flange wear. 2500 w. Am Engr & R R Jour—May, 1900. No. 33951 C.

Flat Car.

Flat Car of 77,000 Lbs. Capacity, North Belgian Railway. An interesting example of fine car construction is illustrated and described. 1500 w. R R Car Jour—May, 1900. No. 34220.

Locomotive Performance.

Performance of the Cleveland Locomotive. Describes an experiment tried on the Intercolonial Ry. of Canada, applying a system of dual exhaust. 1000 w. Am Engr & R R Jour—May, 1900. No. 33954 C.

Locomotives.

A Locomotive Study. Edward Grafstrom. Illustrates a novel adaptation of the wide firebox to a fast passenger engine of the American type. Offered as a suggestion. 700 w. Am Engr & R R Jour—May, 1900. No. 33952 C.

British Locomotives at the Paris Exhibition. Illustrates two engines to be shown, giving brief notes concerning them. 500 w. R R Gaz—May 18, 1900. No. 34349.

Tractive Power of Two-Cylinder Compounds. C. J. Mellin. Describes the development of the tractive power of compound locomotives. 1000 w. Am Engr & R R Jour—May, 1900. No. 33957 C.

Caledonian Railway Passenger Locomotives. Illustrated detailed description of latest types, with account of some of the performances. 1000 w. Engng—May 18, 1900. Serial. 1st part. No. 34463 A.

Mogul Locomotive for the Great Northern Railway of England. View and dimensions of an engine to be exhibited by Baldwin Locomotive Works, at the Paris Exhibition. 500 w. R R Gaz—May 18, 1900. No. 34348.

Consolidation Locomotive, Austrian State Railways. Illustrated description with general dimensions. 500 w. Engr, Lond—May 18, 1900. No. 34470 A.

Atlantic Type Passenger Locomotive. Illustration and dimensions of one of ten locomotives recently built by the Baldwin Locomotive Works for the French State Railways. 300 w. Am Engr & R R Jour—May, 1900. No. 33956 C.

Brooks Ten-Wheel Passenger Locomotive, D., L. & W. Ry. Illustrates one of seven handsome engines recently delivered, noting points of interest. 600 w. Ry & Engng Rev—May 5, 1900. No. 34083.

Four-Cylinder Compounds. Illustrates the principal features in the construction of the designs of F. W. Webb, of the London & North Western Ry. 800 w. Am Engr & R R Jour—May, 1900. No. 33950 C.

Old Norris Freight Engines on the Pennsylvania Railroad. C. H. Carruthers. Illustrated description of engines built in 1854. 1200 w. R R Gaz—May 4, 1900. No. 33991.

Richmond Ten-Wheel Freight Locomotives, R., F. & P. Ry. Specifications, illustration, and comments. 600 w. Ry & Engng Rev—May 26, 1900. No. 34443.

Two Large Consolidation Locomotives. Illustrated detailed description of two large engines, with dimensions. 2200 w. Eng News—May 17, 1900. No. 34311.

Shops.

See under Permanent Way and Buildings, below.

Siberian Train.

A Siberian Train-de-Luxe. From the St. Louis *Globe-Democrat*. Illustrations and description of the Russian idea of a fine train. 1500 w. R R Car Jour—May, 1900. No. 34221.

NEW PROJECTS.

Austria.

Plans for Building Several Austrian Railroads at the Cost of the Government, Particularly a Second Railway Connection with Triest (Die Projectierte Herstellung mehrerer Oesterreichischer Eisenbahnen auf Staatskosten insbesonders eine Zweite

Eisenbahnverbindung mit Triest). The full official report on the project, with maps. Serial. 1st part. 2 plates. 19000 w. Oest Monatschr f d Oeff Baudienst—May, 1900. No. 34155 G.

Bagdad Ry.

The German Bagdad Railway. Considers the routes, the difficulties, and the greatness of the enterprise. Map. 1500 w. Engr, Lond—May 11, 1900. No. 34370 A.

British Columbia.

The Canadian Pacific Railway, from Laggan to Revelstoke, British Columbia. William S. Vaux, Jr. Briefly reviews the history of the transcontinental line of the Canadian Pacific Ry., and calls special attention to interesting features in the section named. Map and illustrations. 4200 w. Pro of Engs' Club of Phila—May, 1900. No. 34297 D.

Connecting Roads.

Certain "Connecting" Railroads in New York City. An account of the projects for connecting the New York Central & Hudson Riv. with the Long Is. Railroad, and the tunnel road to connect the roads terminating in New Jersey, with the Long Is. R. R. Ill. 700 w. R R Gaz—May 11, 1900. No. 34236.

Extension.

Completion of the Atchison to San Francisco. An account of the San Francisco and San Joaquin Valley, a proprietary line forming a connecting link for a great transcontinental line to the Pacific metropolis. 1200 w. R R Gaz—May 4, 1900. No. 33989.

Siberian Ry.

The Great Siberian Railway. M. Mikhailoff. An interesting review of this work, the resources of the country, and the effect upon the development. Map. 7000 w. N Am Rev—May, 1900. No. 33987 D.

West Virginia.

New Railroads in West Virginia. An account of new projects and extensions under contract or construction. 1200 w. R R Gaz—May 11, 1900. No. 34235.

PERMANENT WAY AND BUILDINGS.

Block-Signals.

Block-Signal System for Single-Track Railroads (Streckenblockeinrichtung für Eingeleisige Bahnen). Georg Rank. Description of a system designed by Siemens and Halske, with diagrams. 2500 w. Zeitschr d Oest Ing u Arch Verein—April 13, 1900. No. 34136 B.

Improvements.

Improvements on the Ann Arbor Railroad. An account of heavy construction work in the improvement of grades. 700 w. Ry Age—April 27, 1900. No. 33928.

Louisville & Nashville Terminal Improvements, Pensacola, Fla. Illustrates and describes a grain elevator and conveyor, and warehouse. 900 w. Ry & Engng Rev—April 28, 1900. No. 33931.

Recent Improvements in the Sayre Shops, L. V. Ry. Illustrated description of enlargement of shops and connections made, new paint shop, etc. 900 w. Ry & Engng Rev—April 28, 1900. No. 33933.

The Chesapeake & Ohio's Work at Richmond. Brief illustrated account of the new viaduct, new station, and new freight yard. 1800 w. Ry Age—April 27, 1900. No. 33926.

Interlocking.

Low-Pressure Pneumatic Interlocking at Jersey City. Illustrated description of an interlocking plant of the Erie R. R. at Grove st., Jersey City. 1500 w. R R Gaz—May 25, 1900. No. 34415.

Interlocking Protection for Grade Crossings. J. I. Vernon. Read before the Ry. Sig. Club. Illustrates and describes the general method in use at the present time, also a crossing protected by detector bars and signals. 1800 w. Ry & Engng Rev—May 5, 1900. No. 34084.

Shops.

The New Locomotive Repair Shops of the Philadelphia & Reading R. R., at Reading, Pa. Illustrated description, with two-page plate, of this large and complete plant. 3000 w. Eng News—May 24, 1900. No. 34412.

Extensive Locomotive Repair Shops, Philadelphia & Reading Ry. Illustrated description of new shops to be built at Reading, Pa., with a capacity of 100 locomotives. 2300 w. Ry & Engng Rev—May 19, 1900. No. 34353.

Signals.

Manual Controlled and Automatic Signals. Alexander Holley Rudd. Considers the disadvantages of each system, and the advantages that may be gained by combining the two. 4000 w. Eng News—May 10, 1900. No. 34225.

The Controlled Manual and Automatic Block Signaling Systems. C. C. Anthony. A comparison of the degree of safety, facility of moving trains, general satisfaction, first cost, and cost of operation and maintenance. 2600 w. R R Gaz—May 25, 1900. Serial. 1st part. No. 34416.

Automatic Electric Signals at the Paris Exhibition. Illustrates and describes the system worked out by I. A. Timmis. 1200 w. Engng—May 18, 1900. No. 34464 A.

Station.

New Union Station at Grand Rapids, Mich. Illustration with description. 1000 w. Ry & Engng Rev—May 5, 1900. No. 34082.

New Union Station for the Pennsylvania R. R. at Pittsburg, Pa. Brief description, with illustration. 300 w. Eng News—May 10, 1900. No. 34231.

Switchbacks.

The Switchback Lines of the Great Northern and Northern Pacific Railways over the Cascade Range. Illustrated description of switchbacks built to avoid delay in the construction of tunnels, and afterwards superseded by tunnel lines. 2000 w. Eng News—May 3, 1900. No. 33980.

Tracks.

Some Methods of Repairing Tracks in Europe. Editorial on the methods employed, the advantages and objections. 1000 w. Ry & Engng Rev—May 5, 1900. No. 34085.

Vienna Railroad.

The Superstructure of the Vienna Railroad. From a lecture by Hugo Koestler. Detailed description, especially considering the joint construction. 2000 w. R R Gaz—May 4, 1900. No. 33990.

TRAFFIC.

Passengers.

The Growth of Passenger Traffic. Editorial review of statistics of the Interstate Commerce Commission, comparing the growth of the traffic in the United States with foreign countries. 1600 w. R R Gaz—May 11, 1900. No. 34237.

Rates.

Railway Rates for Coal and Coke. George Johnson. Information concerning British rates of transportation. 1200 w. Col Guard—May 4, 1900. No. 34264 A.

STREET AND ELECTRIC TRAMWAYS

Berlin.

Discussion of the *Union-Elektricitäts Gesellschaft's* Plan for Operating the Berlin *Ringbahn* Electrically (Besprechung über den von der Union-Elektricitäts-Gesellschaft in Berlin Aufgestellten Entwurf für Einführung des Elektrischen Betriebes auf der Berliner Stadt- und Ringbahn). Long discussion before the *Verein Deutscher Maschinen-Ingenieure* on the comparative merits of steam and electrical operation. 12000 w. Glaser's Annalen—April 15, 1900. No. 34119 D.

Bohemia.

The Aussig (Bohemia) Electric Street Railway (Die Aussiger Elektrische Strassenbahn). An illustrated description of this tramway, built by the Union Electric Co., of Berlin. 1200 w. Mitt d Ver f d Förderung d Local u Strassenbahnwesens—April, 1900. No. 34156 D.

British Tramways.

The Calculation of Distributing Systems of Electric Traction Under British Conditions. H. M. Sayers. States the conditions of working electric tramway systems and their effects, considering these systems in practical use. 7700 w. Brit Inst of Elec Engs—May 3, 1900. No. 34214 D.

Street Railways in British Towns. Robert Donald. Compares municipal systems with company enterprises. 2700 w. Munic Af—March, 1900. No. 34243 C.

Car Fuses.

Electric Car Fuses; Why They Blow. P. E. Charles. Part first discusses some of the causes. 1600 w. Am Elect'n—June, 1900. Serial. 1st part. No. 34460.

Competitive Tests.

The Tests of Train-Unit Controlling Systems in the Boston Subway. Particulars and views of the apparatus used in the tests of the Boston Elevated R. R. Co. to decide what make of apparatus to use for the equipment of the trains of the new elevated lines. 2500 w. St Ry Jour—May 5, 1900. No. 34020 D.

Dublin.

The Ringsend Power Plant of the Dublin United Tramways Company at Dublin. A. C. Shaw. Brief review of the history of the Dublin United Tramways Co., with illustrated detailed description of the plant and outside equipment. 7500 w. St Ry Jour—May 5, 1900. No. 34017 D.

Dublin Electric Tramways. Illustrated detailed description. 3300 w. Elec Rev—April 20, 1900. Serial. 1st part. No. 33946 A.

Early Railways.

The First Railway Engineer. An account of William Jessop and his work—1745-1814. 2200 w. Engr, Lond—April 27, 1900. No. 34074 A.

Electric Traction.

The Application of Electric Traction to Existing Railways. Ed. C. de Segundo. Part first refers to the possibility of traveling from New York to Boston by trolley, and the application of electricity to suburban railways. 2000 w. Elec Rev, Lond—May 11, 1900. Serial. 1st part. No. 34363 A.

Electric Traction on the Metropolitan Railway, London. Details as to the permanent way and the equipment. 3300 w. Engr, Lond—May 18, 1900. No. 34471 A.

Electrolysis.

Electrolysis from the Ground Return Current of Street Railways. Albert B. Herrick. Read before the N. Y. Elec. Soc. An explanation of the causes and the damage, the methods of testing to discover the flow and points of departure, and the remedies. Ill. 4000 w. St Ry Jour—May 5, 1900. No. 34024 D.

Electrolysis. E. H. Jenkins. Read at meeting of the Southwestern Assn. Reviews briefly the various systems for overcoming the difficulty. 1000 w. St Ry Rev—May 15 1900. No. 34352 C.

Extension.

Suburban Extension of Union Railroad Company at Providence. Burcham Harding. Describes a new extension following the south shore of Narragansett Bay, and passing through a series of summer resorts. Ill. 700 w. W Elect'n—May 5, 1900. No. 34090.

Glasgow.

Glasgow's Municipal Tramways. Milo Ray Maltbie. Facts and figures gathered in Glasgow and verified, showing great advantages as compared with private operation. 6500 w. Munic Af—March, 1900. No. 34244 C.

Halifax.

Electric Railway System of Halifax, N. S. E. M. Archibald. An illustrated detailed description of the line and its equipment. 2000 w. St Ry Jour—May 5, 1900. No. 34018 D.

Jungfrau.

The Jungfrau Three-Phase Electric Railway. W. H. Molesworth. An illustrated descriptive account of the electrical features of this remarkable engineering work. 3800 w. Elec Wld & Engr—May 12, 1900. No. 34286.

Monorail.

The Single-Rail Suspended Railway Between Barmen, Elberfeld and Vohwinkel (Einschienige Schwebebahn Vohwinkel-Elberfeld-Barmen). Mainly abstracted from a publication of the "Continentale Gesellschaft für Elektrische Unternehmungen" of Nuremberg. A well illustrated description of this interesting railway. 3200 w. Stahl und Eisen—March 15, 1900. No. 34100 D.

Moscow.

Important Changes Proposed in the Tramways of Moscow. Extracts from the report of A. Lineff, a Russian engineer, discussing points to be considered in changing all the system to electric lines and for the construction of new lines. Ill. 1500 w. St Ry Jour—May 5, 1900. No. 34023 D.

Multiple Unit.

A New System of Multiple Unit Control. Report of experiments being made in the subway, in Boston, with the electric-pneumatic system of train control. 1000 w. Elec Rev, N. Y.—May 2, 1900. No. 33967.

Norwich.

Norwich Electric Tramways. An account of the opening of twenty miles of electrically equipped tramways in a city that has not possessed a tramway of any description. Illustrates and describes the line. 1300 w. Elect'n, Lond—May 18, 1900. Serial. 1st part. No. 34475 A.

Operating Tests.

Simple Operating Tests for Electric Railways. Illustrates and describes eleven convenient tests. 3800 w. St Ry Jour—May 5, 1900. No. 34022 D.

Operation.

Operation and Maintenance of Street Railways. H. F. MacGregor. Read at meeting of the Southwestern Assn. Suggestions from the experience of the writer. 1600 w. St Ry Rev—May 15, 1900. No. 34351 C.

Paris.

Recent Railway Work in and About Paris (Neuere Eisenbahnbauten in und um Paris). H. Frahm. A general account of railway terminal and street railway work, well illustrated, in a paper read before the *Verein für Eisenbahnkunde*, Berlin. 7500 w. Glaser's Annalen—May 1, 1900. No. 34121 D.

Paris Exposition.

Transportation Systems of the Paris Exposition. Illustrated detailed description of the three means of travel provided: the moving side-walk, the electric railroad, and the extension of the Railroad of the West. 2500 w. St Ry Jour—May 5, 1900. No. 34021 D.

Stray Currents.

The Influence of Vagrant Currents from Electric Tramways Upon Magnetic Observatories. J. Edler. Abstract translation from *Elektrotechnische Zeitschrift*. An account of the investigations at the Potsdam observatory. Ill. 2000 w. Elect'n, Lond—April 20, 1900. No. 33912 A.

Surface Contact.

The Westinghouse Electro-Magnetic Traction System for Tramways. Illustrated description of this surface-contact system, recently designed. 1500 w. Engr, Lond—April 27, 1900. No. 34075 A.

Surface Contact System at Monaco. Brief illustrated account of the most successful surface contact electric railway in the world. 900 w. St Ry Jour—May 5, 1900. No. 34019 D.

Suspended Road.

See Monorail, above.

IMPROVED MACHINERY

New Processes and New Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

New Fox Trimmer.

THE accompanying illustration represents one of a new line of pattern-makers' wood trimmers just perfected by the Fox Machine Co., 837 North Front street, Grand Rapids, Mich., U. S. A. In this style the bed carrying the frame, etc., is mounted on a hollow pedestal, the latter having a wide base, insuring a solid support. The entire top of the machine swivels on the column, so that a cut may be made on either gauge without the operator's moving his position, or, when desired, the bed may be firmly locked in any position by a hand wheel inside of the column. The pedestal is mounted on three casters, so that the machine may be easily moved about the shop. One of the casters is on an eccentric and may be thrown on or off at will, by means of the lever shown, the machine setting on lugs on the under side of the base when this caster is not in use. The form of the bed allows the operator to stand close to the work. The knives are perfectly shielded on both sides by caps, and the carriage and knives are unusually heavy. Power is transmitted from the hand levers to the carriage by a large sprocket wheel on the lever shaft, a smaller sprocket at each side of the machine, and a special heavy chain of nickel-steel, the chain being attached to the carriage with a provision for adjusting the tension. The gears and bearings are protected from dust and chips, and the hand lever pivot is low down, giving an easy leverage.

Although of extremely large capacity these tools are as convenient and accurate on small work as on any other size. Fuller particulars are given in a catalogue on wood-trimmers, sent by the builders on request.

Asbestos Sheathing.

AT the seventh general meeting of the Society of Naval Architects and Marine

Engineers Assistant Naval Constructor R. M. Watts, U. S. N., read a paper from which we make the following extracts, the four plates referred to being reproduced herewith.

"A non-conducting, incombustible, splinter-proof covering for use in living spaces on the inside surface of the outer shell of steel vessels, and for magazines, coal-bunkers, and boiler-room bulkheads, has been developed in conjunction with the H. W. Johns Manufacturing Company. The wooden sheathing or panelling at first used in such places was replaced because of its combustible qualities by a light steel sheathing, which has been a source of constant complaint of discomfort and danger

to health. Because of the numerous complaints, the asbestos sheathing was developed to meet the objections to both steel and wood sheathing. This it fully does. The finished sheathing possesses the primary requirements of a non-conducting, incombustible, splinter-proof covering; it is light in weight; in appearance it is clean, neat, and ornamental, as shown by Plates 11, 12, 13; further, it adds to the comfort and habitality of living spaces, being warm in winter and cool in summer. The total weight of the completed sheathing, including framework and fastenings, averages six and one-half pounds per square foot. I regret that the work was in such condition as not to allow of temperature experiments during the extreme heat of summer, but data taken during the mild heat of September show that the effect of the sheathing on the side of the ship exposed to the direct rays of the sun was to reduce the temperature from twenty to thirty-five degrees Fahrenheit.

"After various trials, the following method of fitting has been adopted as the most satisfactory, and will be readily understood by reference to Plate 11, which shows adjacent frame spaces in successive stages of completion. Betwen the ship's frames, or bulkhead stiffeners, and one and a half inches from the inner edges, is fitted a framework of one inch by one inch by three-sixteenths inch steel angle bar horizontally, and one inch by three-sixteenths inch flat bar vertically, so spaced as to provide the necessary stiffness, and to carry bolts which extend to secure the finishing mouldings. Over this framework is drawn number nineteen galvanized iron wire cloth, one-half-inch mesh. Over the wire cloth, asbestos fire felt (a very light, porous asbestos) in sheets one and one-half inches thick, is secured by galvanized sheet iron or wire cloth washers and copper wire. This fire felt is flush with the surface of frames, or edges of angle bars. Asbestos millboard, three-eighths inch thick, is placed over the fire felt to secure a smooth, hard finish, and is held in position by galvanized iron mouldings, one-eighth inch thick and

an inch and one-half wide, set up by countersunk nuts on the bolts carried by the inner frame. At the proper height is also a galvanized sheet iron chair rail, four and one-half inches wide. All interstices around air ports and elsewhere are filled in with asbestos cement. The millboard is coated with sizing to prevent absorption, and then painted with white enamel and gold striped, resulting in a pleasing and symmetrical panel effect. The finishing mouldings come over the seams of sheets, and the size of panels must therefore be considered in connection with the commercial sizes of asbestos fire felt and millboard sheets.

"This asbestos sheathing has been fitted around the engine-room trunk in junior officers' quarters on the New York; in the wardroom of the Indiana, as shown by Plate 12, where it was fitted in portable sections; in the ward-room and certain staterooms on the Massachusetts, Plate 13; and in officers' quarters on the Atlanta and the Cincinnati, where the method of fitting is as above described. In the Atlanta's cabin, the outboard side and the under side of the turtle-back deck over the cabin have been sheathed as explained, while for the other bulkheads asbestos millboard only has been used. The result is shown by Plate 10.

Spherical Type of Dynamos and Motors.

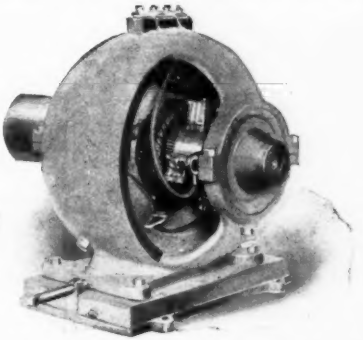
THE accompanying illustration represents a new type of dynamo brought out by Roth Bros. & Co., of Chicago. These machines are spherical in design, symmetrical and very compact.

In the design of these machines unusual attention is given to the exact proportions, and the selection of the best material conducive to high efficiency and economic operation, and the highest class of workmanship is embodied in their construction.

The magnet frame is of cast steel or soft cast iron, according to size. The field cores are of very soft cast steel, with a pole shoe of a special design and shape, rendering the machines capable of a large variation of load without sparking. These cores are deeply set into the magnet frame, so as to make a perfect magnetic joint with a very large contact surface, and are held in place by large bolts.

The armature is of the iron-clad type, with a core built up of thin annealed soft steel sheets, the number of slots in the armature core being in accordance with the best practice of modern designs. The coils for the armature are machine wound, and are all of the same length and interchangeable. Each coil is separately insulated and tested for perfect insulation. The method of winding is very simple, and in case of accident admits of easy repairs.

A large number of segments of best tempered copper are used in the commutator, thoroughly insulated with mica. On ac-



count of the great number of segments employed, combined with a large wearing surface, cool running and sparkless operation are assured even under heavy overload.

The brush-holder is of a special design, made to hold a number of square carbon brushes, each brush being independently pressed to the commutator by a spring, insuring constant contact, and they feed automatically. Self-oiling and self-centering bearings, provided with sleeves and two oil rings, are used, thus ensuring perfect lubrication. The bearings are so designed that by giving them a quarter or half turn the machine can be inverted for suspension to the wall or ceiling.

By means of cover plates the openings at either end of the machines can be enclosed, thus making an entirely enclosed motor or dynamo. These cover plates are furnished when such machines are desired.

A New Type of Ventilating Fan.

DURING the past year the B. F. Sturtevant Co., of Boston, has remodelled its

enclosed motors designed for direct connection to propeller fans and is now building a full line of these useful machines, ranging from eighteen inches to 120 inches in diameter, with capacities from 2,000 to 175,000 cubic feet per minute. The motor is of the bi-polar type, entirely enclosed, and thereby protected from dust, a most important element in a machine used under these conditions. In order to avoid the excessive temperature which is incident to the operation of most enclosed motors, this type has been very carefully designed, so that a low temperature rise can be maintained without greatly increasing the size and weight above

that of the ordinary open type. This machine is capable of continuous operation for ten hours, with a maximum temperature rise not exceeding 60° F.

Yokes extending out from the field ring support the armature shaft. The end castings are entirely independent and can be instantly removed to give access to the entire interior. The bearings and brushes can be reached by simply removing the caps in the center of the casings.

The brushes are of hard carbon, in holders of a modified reaction type, which allows of easy adjustment when it becomes necessary to reverse the direction of rotation of the motor. The bearings are self-oiling and self-aligning and fitted with composition sleeves, which are removable from the outer ends of the boxes.

The design of the propeller wheel is the result of an extended series of comparative experiments with different types. The delivery edge is helical, and the form is such that the air is packed up at the inlet edge of the blade at low velocity, and when well under the influence of the blade is accelerated to its maximum velocity with the least amount of slip. As a result, the efficiency is extremely high. The wheel is partially enclosed within a conoidal inlet ring, which decreases the frictional resistance to the entering air. By means of a tripod support the motor is accurately centered and rigidly held in place, and the entire apparatus may with ease be bolted directly to the wall through which the air is to be discharged. The illustration serves to make clear the general features of the design.

Industrial Notes.

The Berlin Iron Bridge Co., of East Berlin, Conn., have received the contract for thirteen important bridges on the N. Y., N. H. & H. R. R. Ten of these are large heavy four-track bridges, and three of them are to carry highways over the tracks. Six are located at Bridgeport, Conn., and are plate girder bridges for carrying tracks over the streets. There is also a very long, heavy four-track riveted lattice bridge on the Plymouth Division, near Boston. All the work is to be completed by October 1.

The new boiler and power house for the Albany & Hudson Railway & Power Company will be located at Stuyvesant Falls, N. Y., and will be a fire-proof construction throughout. It will be furnished by the Berlin Iron Bridge Company, of East Berlin, Conn.

Mr. Frederick Schoff, proprietor of the Stow Flexible Shaft Company, reports a steady and constantly growing demand for their electric portable drills, in addition to which orders are booked for a number of crank-pin turners, boring bars and planers. Recent shipments include boring bars, planers and crank pin turners to St. Louis, boring bars to Michigan; electric portable drills to Brooklyn, N. Y., and Portland, Me. Several electric portable drills are

about ready for shipment to Paris, France, as also are boring bars for Russia. A western slaughter house has placed an order with this house for a saw to run by flexible shaft, to be used for cutting up hogs. They have also just received an order from the United States Navy Yard at Port Royal, S. C., for three of their largest electric portable drills.

Railway motor engineering is a new course of instruction offered by the International Correspondence Schools, Scranton, Pa. The course was prepared and is being kept up to date by Eugene C. Parham, superintendent of the Nassau Division of the Brooklyn Rapid Transit. It is intended for operators and those who wish to become operators of electrical machinery, and contains practical instruction on the operation and maintenance of electric cars and motors. As instruction is carried on by mail, it affords a means of acquiring valuable information without obliging students to lose time from work.

The O. H. Jewell Filter Co., Chicago, Ill., have just received from the Terre Haute Water Co., of Terre Haute, Ind., their second order of this year to increase the filter plant already installed in their works. This increased order is for filters of a capacity of 4,500,000 gallons in 24 hours, the original filter plant being 4,000,000 gallons' capacity in 24 hours. The filters are of the horizontal pressure type.

The Lea Manufacturing Company, manufacturers of the Lea enclosed arc lamps, and the Robinson Electric Heater Company, owners of the Robinson electric heating apparatus and rheostats, have been absorbed by the Lea Electric Manufacturing Company, of Elwood, Ind. The new company will increase its shop facilities so as to be able to keep up with the increasing demand for the Lea arc lamp. It will put on the market a line of heating devices, rheostats and special resistances of a very novel character and using a new resisting material. Mr. Mortimer Levering, of La Fayette, Ind., is president; Jacob Loomis, of Elwood, Ind., is vice-president and general manager; Conway Robinson, formerly of Baltimore, Md., is assistant manager and engineer, and H. H. Thacker, of Elwood, Ind., is secretary.

Mr. Sidney H. Wheelhouse, formerly sales agent for the Chicago Pneumatic Tool Co., has been appointed second vice-president of the Standard Railway Equipment Co., in charge of the pneumatic tool sales department for the West, with offices 412-414 Lincoln Trust Building, St. Louis.

The New York office of the Detroit Graphite Manufacturing Co. announce their removal to 141 Broadway, Washington Life Building, where more central and commodious quarters have been secured to handle the rapidly increasing sales of their well-known brand of superior graphite paints, which are used for coating metal surfaces.

In one of the shops of the United States Cast Iron Pipe and Foundry Company, Cincinnati, O., the company has fitted up a room with drawing tables, boards and T-squares as a study room for the use of a number of its employees who are students of the International Correspondence Schools, Scranton, Pa. The class, which numbers about fifty men, and includes the general manager, studies on "company time," and is supplied with drawing paper by the firm. All promotions in the shops will hereafter be made from students of this class.

The J. A. Fay & Egan Company, of Cincinnati, O., are making a noteworthy display of wood-working machinery at the exposition at Paris. They will illustrate and show in operation complete equipments on the American plan for car shops, railroad shops, arsenals, ship yards, furniture factories, chair factories, joinery shops, and, in fact, all machines for working wood, complete and in the most improved American state of the art. Competent assistants are in charge to illustrate and show what each machine will do. They also have a complete band saw mill, which will cut timber on the most advanced and improved principle, and will cut quarter oak and short wood to the very best advantage.

It does not seem to be generally known among mine owners that the Edward P. Allis Company, of Milwaukee, conducts well-appointed mining machinery departments in connection with their New York and Chicago offices. Users of mining machinery can be served either from their New York offices, 95 Liberty street, or the

Chicago office, 509 Home Insurance Building, with the same efficiency as from the Milwaukee office.

Among many large orders lately received by the Green Fuel Economizer Co., of Matteawan, N. Y., there is one from the Manhattan Railway Co., New York City, for their new 100,000 horse power plant. These economizers are to be installed in the Manhattan Railway Company's new power house, which they are building at Seventy-fourth street and East River. When this plant is completed it will be the largest plant of economizers running in the world. This large order follows closely on one from the Third Avenue Railroad Company for their Kingsbridge power house for economizers to be applied to 32,000 B. H. P.

The Philadelphia Pneumatic Tool Co. reports a rapidly increasing demand for their tools. Their Chipping and Caulking Hammers seem to be particularly in demand, large orders having recently been received from the Pennsylvania Steel Co., Baldwin Locomotive Works, Brown & Sharpe Mfg. Co., Ingersoll-Sergeant Drill Co., The Bigelow Co., and many other representative concerns. In all cases their Hammers were adopted after severe competitive tests.

This company have been obliged to more than double the capacity of their shops since the 1st of January. They have established agencies in all the leading cities of Europe, and also in Japan.

The Clayton Air Compressor Works, New York City, have recently perfected a new type of duplex belt air compressor. These machines are built in small and intermediate sizes and embody all of the latest improvements. They have also recently equipped five plants of the Brooklyn Heights Rapid Transit Company with compressors and pneumatic hoists, as well as plants for the Grasselli Chemical Company, General Chemical Company, De La Vergne Refrigerating Machine Company, Union Brewing Company, Gill Machine Works, White Machine Shops, etc. Their export trade has more than doubled, and they are shipping their product to England, Germany, Russia, France, Italy and Japan. Many orders are being received from Mexico and South America.

The Ingersoll-Sergeant Drill Co., New York, had all its air compressors at the Paris Exposition erected and ready to run on the opening day, being the first American exhibitor to operate, and the first exhibitor from any country to run its exhibit by steam. Mr. John J. Swann is in charge of this exhibit.

A large duplex air compressor has been ordered from the New York Air Compressor Company, to be used in connection with the Standard Railway Signal Company's installation on the New York Central & Hudson River Railroad. This machine is the first of two to be located in the engine room at the Grand Central Station.

Mr. J. W. Duntley, president of the Chicago Pneumatic Tool Company and also president of the New York Air Compressor Company, who has just returned from Europe, brought with him an order for twelve air compressors for European shipment. The New York Air Compressor Company has also received an order for one of their compressors to be shipped to Yokohama, Japan.

The New York, Ontario & Western Railroad Company has recently installed in its shops a duplex Steam Driven Air Compressor built by the New York Air Compressor Company.

Harrison Bros. & Co., Inc., Philadelphia, have succeeded in producing a white enamel suitable for exterior work, and have placed it on the market under the name of "Weatherproof" white enamel. It is designed for use on outside work, such as deck houses and hulls of ships and yachts, store fronts, etc. It is equally good for iron or wood surfaces, will not check, crack or flake under the most severe exposure to all weather conditions and is specially well adapted to use in salt atmosphere and localities where acid or alkaline vapors abound. Soot and smoke do not readily adhere to it, or if they do, they can be easily removed by simply flushing with water.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Henry Maurer & Son, New York.—Pamphlet (14th edition) describing the "Herculean" terra-cotta arch, and a novel method of fireproof construction employing terra-cotta blocks, filled in with cement reinforced with iron T rods.

Sprague Electric Company, New York.—Bulletin No. 500, describing the Bowles safety system of electric water-tight doors in bulkheads on steamships, well illustrated.

Davis Heater Company, Racine, Wis.—Circular devoted to hot water and steam heaters for heating buildings, and heaters for warming water for domestic purposes, etc.

The Borden & Selleck Company, Chicago, Ill.—A handsome catalogue containing illustrations of plants in which Harrison conveyers have been installed, and giving details of this conveyer and its various attachments.

The Mason Regulator Co., Boston, Mass.—Catalogue of steam regulating devices, including reducing valves, pump pressure regulator, pump governors, elevator pressure regulator, etc., and the Mason improved steam pump. With telegraph code.

Bethlehem Steel Company, South Bethlehem, Pa.—A finely illustrated brochure, giving an interesting description of the successive steps in the manufacture of armor plate, ordnance and forgings, from the raw material to the finished product, as practised at the Bethlehem works.

The Bristol Company, Waterbury, Conn.—Pamphlet giving a list of Bristol's recording instruments, including vacuum and pressure gauges, water level or tide gauges, thermometers, volt, ampère and watt meters, and accessories; with prices.

The Wm. Powell Co., Cincinnati, O.—Catalogue No. 7, devoted to high grade steam brass goods and specialties, including many kinds of valves, lubricators, oilers, etc., with useful mechanical engineering tables.

Fort Wayne Electric Works, Fort Wayne, Ind.—(*a*) Bulletin No. 1006, describing the "Wood" arc lamp suspension cut-out, a device for connecting arc lamps for interior illumination in circuit and cutting them out. (*b*) Bulletin No. 1007, containing a well illustrated description of the "Wood" new focusing series arc lamp, in which the focusing mechanism is entirely distinct from the feeding mechanism. (*c*) Bulletin No. 1008, devoted to medium sized generators for light and power.

H. Ward Leonard, Bronxville, N. Y.—Pamphlet giving technical and popular descriptions of the Ward Leonard system of control for electric motors, with opinions and reports on its practical operation.

The Brown Hoisting and Conveying Machine Company, Cleveland, O.—Descriptive circular of automatic tubs and buckets for many purposes, with illustrations, tables and prices.

Ward Leonard Electric Co., Bronxville, N. Y.—(*a*) Catalogue No. 1900, of rheostats and circuit breakers, including Carpenter enamel rheostats, Ward Leonard motor starters and speed-controllers, theatre dimmers, Ward Leonard automatic circuit breakers, etc., well illustrated. (*b*) Circular with description of the Ward Leonard-Westover steam carriage.

Arnold Electric Power Station Company, Chicago, Ill.—(*a*) Bulletin No. 1, containing an illustrated description of the Chicago and Milwaukee Electric Railway, which was designed and built complete by this company, on the Arnold system, combining alternating and direct current transmission and auxiliary storage batteries. (*b*) Bulletin No. 2, giving an illustrated description of the plant of the Imperial Electric Light, Heat and Power Co., St. Louis, Mo., also built complete by the Arnold Co.

American Sewage Disposal Company, Boston, Mass.—Circular describing their sewage disposal system with primary and secondary filter-beds and settling or septic tanks.

Erie City Iron Works, Erie, Pa.—Catalogue with handsome illustrations and description of "four-valve" automatic cut-off steam engines.

Bullock Electric Mfg. Co., Cincinnati, O.—(*a*) Bulletin No. 34a, with illustrations and descriptions of railway, light and power generators, designed for direct connection to steam engines or other prime movers. (*b*) Bulletin No. 36, devoted to marine lighting and power sets, with illustrations of some that have been installed on yachts.

C. W. Hunt Company, New York.—(*a*) Catalogue No. 002, devoted to industrial railways for manufacturing establishments, with descriptions and many illustrations of tracks, cars and other accessories. (*b*) Pamphlet No. 001, with illustrations showing the application of the Hunt industrial railway to the large manufacturing establishment of Ldw. Loewe & Co., Berlin, Germany. (*c*) Pamphlet No. 005, describing "Stevedore" transmission rope, made from selected manila fibre, and patent couplings.

NEW CATALOGUES.

St. Louis Iron and Machine Works, St. Louis, Mo.—Catalogue devoted to the St. Louis "Corliss" steam engine, with many illustrations of engines and their parts, and views of the works of the company.

The Auto-Electric Air Pump Co. New York.—Catalogue No. 2, describing an improved, compact air pump, for the use of physicians, dentists, artists, printers, hotels, saloons, and for inflating bicycle and automobile tires.

Wilbraham Baker Blower Co., Philadelphia, Pa.—Catalogue containing an illustrated description of the "Green Patent" positive rotary pressure blower and exhauster, with data concerning the speed of blowers, quantity of air displaced, etc.

Boston Belting Company, Boston, Mass.—(*a*) Booklet giving a list of all kinds of vulcanized rubber goods, belting, hose, packing and mechanical rubber goods of every description. (*b*) Illustrated catalogue of packings, valves, gaskets, and diaphragms.

The Watson-Stillman Company, New York.—Catalogue No. 56, devoted to hydraulic pumps, being an assortment of illustrated sheets selected from the illustrations of hydraulic tools manufactured by the company, including test pumps, plunger pumps, and many other kinds, hydraulic valves, gauges, packings, etc. Telegraph code attached.

Garton-Daniels Company, Keokuk, Ia.—Catalogue No. 24, devoted to Garton lighting arresters for electric light, power and railway circuits of any voltage, direct or alternating current; with telegraph code.

Commercial Electric Company, Indianapolis, Ind.—(*a*) Circular No. 110 (2nd edition), devoted to slow and moderate speed multipolar motors and generators. (*b*) Circular No. 114, describing iron-clad, moderate and slow speed motors, with illustrations.

Wm. H. Wilkinson & Co., Boston, Mass.—A well illustrated catalogue, containing descriptions of all kinds of oiling devices and oil cups for steam engines and machinery.

Warren Electric Mfg. Co., Sandusky, O.—Bulletin No. 10, with an illustrated description of the Warren induction alternator, a dynamo machine with stationary armature and field coil and rotating steel pole pieces.

Iroquois Iron Works, Buffalo, N. Y.—Very well illustrated catalogue and general description of machinery and tools for asphalt pavements, including steam rollers, street tools, machines for preparing the sand, the asphalt cement and the asphalt-sand mixture, etc.

Chapman Valve Mfg. Co., Indian Orchard, Mass.—This catalogue is a well illustrated, cloth bound volume of 400 pages, devoted exclusively to valves, fire hydrants and their accessories, such as flanges, floor-stands, gearing, indicators, etc.

The Knecht Brothers Co., Cincinnati, O.—Booklet describing a friction sensitive drill press, the driving mechanism of which consists of two cones and a friction roller.

The Carl Anderson Co., Chicago, Ill.—Illustrated booklet devoted to the "Gus" gas and gasoline engines, of from 2 to 25 horse-power.

John Muirhead and Son, Pittston, Pa.—Circular devoted to diamond drill prospecting for coal and ore, and the drilling of artesian wells, oil and gas wells, etc.

Northern Engineering Works, Detroit, Mich.—Catalogue No. 102, devoted to gas and gasoline engines with two single acting cylinders, placed tandem, each cylinder operating alternately on the "four cycle" principle. This secures a "two cycle" effect, or an impulse every revolution.

Hill, Clark & Co., Boston, Mass.—Mailing card with illustration of multiple spindle sensitive drills, made with 1, 2, 3, 4, or 6 spindles; 15 inch swing; ball bearing thrust collars; 3¾ inch feed; counterbalanced table.

Chas. A. Schieren & Co., New York.—(*a*) Illustrated booklet in French, German, Spanish and English about oak-tanned leather belting, from ½ inch to 100 inches wide, calling particular attention to the firm's exhibit at the Paris Exposition. (*b*) Pamphlet, with illustrations of tannery and offices.

Joseph Dixon Crucible Co., Jersey City, N. J.—Circular about silica-graphite paint for the protective coating of steel structures and tin roofs.

National Lubricator Co., Albany, N. Y.—Illustrated booklet describing the National automatic lubricator, which delivers the lubricant by forced feed, positive and regular in its action.

Marine Iron Works, Chicago, Ill.—Pamphlet describing the Watson radial water tube marine boiler. The system of seamless cold-drawn steel tubes is in the form of a vertical cone over a central furnace.

B. F. Sturtevant Co., Boston, Mass.—Illustrated booklet, devoted to mechanical draft, and showing how it was substituted for a chimney at the Sturtevant works.

The Goulds Manufacturing Co., Seneca Falls, N. Y.—Advance pages from 1900 catalogue, giving a partial list of new pumps and accessories, including well force pumps, siphon force pumps, double-acting force pumps, artesian deep well cylinder, etc.

The New Process Raw Hide Company, Syracuse, N. Y.—Catalogue devoted to noiseless, solid raw hide spur, bevel and friction gears, bushings, washers, raw hide bound mallets, etc., with illustrations and price lists.

E. W. Bliss Co., Brooklyn, N. Y.—Illustrated booklet describing the "Bliss-Heath" patent vacuum or atmospheric pumping engine for unskilled labor, designed to raise water from street mains, wells or any other source to elevated tanks.

Crosby Steam Gage & Valve Co., Boston, Mass.—A handsome, cloth bound volume, containing descriptions of instruments for use on steam boilers and steam engines, including gages, valves, pressure recorders, lubricators, indicators, Amsler's planimeter, etc.

NEW CATALOGUES.

Wooley Foundry and Machine Works, Anderson, Ind.—(*a*) Pamphlet describing the Burger automatic gas and gasoline engines of from 30 to 200 horse-power. These engines are "two-cycle," with an impulse at every revolution. (*b*) Pamphlet describing the Burger "four-cycle" gas and gasoline engines, of from 15 to 40 horse-power.

The Winkley Co., Madison, Wis.—Illustrated booklet, devoted to self closing, dust proof oil-hole covers, with price lists.

Gould & Eberhardt, Newark, N. J.—Pamphlet describing the two smaller sizes of their "new type" gear cutting machines for cutting spur gears up to 33 inches diameter and 9 inches face, without further attention than the setting.

C. H. A. Dissinger & Bro., Wrightsville, Pa.—Circular illustrating and describing the "Capital" gas engine, from 5 to 50 horse-power, with price list.

The Shaw-Walker Co., Muskegon, Mich.—Mailing card, calling attention to a card system for expediting office work and making it more efficient.

Chisholm, Boyd & White Co., Chicago, Ill.—Circular about the improved White mineral press, for putting into briquette form fine dust, fine ores, concentrates, calcines, etc.

The Vulcan Iron Works Company, Toledo, O.—(*a*) Illustrated mailing card, calling attention to steam shovels, dipper dredges, elevator bucket dredges, boiler fronts, fine grey iron and brass castings. (*b*) Circular, referring to steam shovels, elevator bucket and dipper dredges, with an illustration of a 60-ton steam shovel, working in Sweden.

Crocker-Wheeler Company, New York.—(*a*) An illustrated and well gotten up brochure, pointing out a few of the peculiar advantages possessed by electric motors for driving printing establishments. (*b*) Reprint from the *Electrical Engineer*, describing the company's works, and showing the application of electric motors to various tools and machines.

Fraser & Chalmers, Chicago, Ill.—(*a*) Catalogue No. 4 (9th edition), Gold and Silver Mills, giving well illustrated and complete descriptions of crushers and stamps and all other kinds of machinery for working gold and silver ores. (*b*) Catalogue No. 6 (9th edition), giving a complete description of the "Comet" rock and ore crushers. (*c*) Catalogue No. 7 (7th edition) of perforated sheet metal, round hole and slot screens for all purposes, with tables of wire gauges, sheet metal sizes, etc. Telegraph code included. (*d*) Catalogue No. 54, of Sederholm boilers for high pressures and large units, with tables of properties of steam, etc. (*e*) Pamphlet No. 55, on the treatment of copper mattes in the Bessemer converter, by Prof. James Douglas. (*f*) Catalogue No. 24 (6th edition), devoted to Riedler pumps, for mine drainage, irrigation, sewage, city water works and hydraulic power plants, with hydraulic and pipe tables.

The Garvin Machine Co., New York.—Catalogue of universal and plain milling machines, lathes, gear cutters and various other machine tools, including special labor-saving machines for bicycle and automobile construction. With tables and telegraph code.

The Fox Machine Co., Grand Rapids, Mich.—Catalogue No. 16, of Fox universal wood trimmers, for trimming pieces of wood smoothly and accurately on any angle.

Meldrum-Morse Destructor Company, New York.—A pamphlet containing illustrated descriptions of some English and American types of destructors for disposing of garbage and utilizing the refuse of cities as fuel for the production of steam power.

Stow Manufacturing Co., Binghamton, N. Y.—Catalogue No. 8, devoted to the Stow flexible shaft and accessories, with various applications in drilling, boring, grinding, tapping, reaming, etc.

Putnam Machine Company, Fitchburg, Mass.—Catalogue of about 200 pages, containing descriptions and illustrations of metal working machines, including planers, drills, milling machines, railroad machine tools, etc.; with a particularly complete line of lathes.

J. A. Fay & Co., Cincinnati, O.—A handsome and completely illustrated catalogue of 394 pages, devoted to wood-working machinery.

Industrial Water Company, New York.—Circular about apparatus for softening and purifying water for use in boilers and for other purposes.

The Merrell Manufacturing Co., Toledo, O.—Catalogue No. 5, containing descriptions of different styles of pipe threading and cutting machines and accessories, with tables of standard sizes of wrought iron welded pipe, casing threads, etc.

The J. A. Fay & Egan Company, Cincinnati, O.—Circular calling attention to their exhibit of a complete line of machinery for wood working, at the Paris Exposition.

The Q & C Company, Chicago, Ill.—Circular describing the Torrey ballast car and a system for loading and distributing gravel and rock ballast from freight trains.

The Standard Tool Company, Cleveland, O.—Catalogue with illustrations and descriptions in English, French and German of twist drills, reamers, chucks, sockets, spring cotters, taps, flat spring and riveted keys, milling cutters and special tools.

American Blower Company, Detroit, Mich.—Catalogue No. 111, devoted to "A B C" disc ventilating fans, used for drying, lowering temperature and removing steam, fumes and gases.

The Under Feed Stoker Company of America, Chicago, Ill.—Catalogue devoted to the Jones under feed mechanical stoker, by which the fuel is introduced below the fire line, with records of tests and comparative data, well illustrated.

Brown & Sharpe Mfg. Co., Providence, R. I.—"Practical Treatise on Gearing," a 150-page book made for men in practical life who would like to know how to construct gear wheels, but who have not acquired a technical education. The twenty-

four chapters comprising this book are very thoroughly illustrated, and the great amount of data given will be found equally as available by the man who has a technical education. Numerous tables render the work especially valuable for reference.

Lidgerwood Manufacturing Co., New York.—A 200-page, handsomely printed catalogue entitled "The Lidgerwood Cableway." The book is profusely illustrated with half-tone engravings from photographs and numerous pen sketches of the cableway as employed in the construction of dry docks, dams, piers, walls, fortifications, etc., as well as for open pit mining, quarrying, logging, discharging vessels and transferring cargoes between ships at sea. The illustrations and descriptive text will be studied with interest by every engineer and contractor having to do with hoisting and conveying materials of any kind in an economical and expeditious manner.

The Rivett-Dock Co., Brighton, Mass.—A four-page circular describing an entirely new departure in a thread-cutting tool designed to turn out accurate threads from three to ten times faster than the common tool. An especially desirable feature is the insurance of accurate duplicates after the first thread has been fitted.

Creamer Perfection Steam Specialties Co., Bayonne, N. J.—A 20-page catalogue illustrating and describing textually the "Perfection" series of steam specialties, such as pump governors and receivers, used in connection with a duplex or other pump, made in two patterns—horizontal and vertical; steam traps, used for automatically draining and returning condensation from steam pipes, cylinders, engines, pumps, drips from steam mains, etc.; high pressure boiler feeder and pump governor; low pressure boiler feeder; and balance valve.

Pond Machine Tool Co., Plainfield, N. J.—A handsomely printed and daintily bound 100-page book entitled "Machine Tools." This is a striking example of the modern catalogue *edition de luxe*, and is intended for distribution at the Paris Exposition. The carefully-printed half-tone illustrations are accompanied by descriptive text in English, French and German.

Ft. Wayne Electric Works, Ft. Wayne, Ind.—Bulletin No. 1010 of May 21, 1900, illustrating and describing the "B & B." commutator truing device. Punched for binding.

Holtzer-Cabot Electric Co., Brookline, Mass.—An illustrated catalogue of a system of interior telephone service especially adapted to machine-shop and factory use. Considerable space is devoted to a description of the "intercommunicating" system, in which no "central" is required, while from any station any other telephone may be rung up without disturbing those not wanted at the moment. Numerous wiring diagrams are given, as well as much information valuable to the owner and user of a telephone.

Bullock Electric Mfg. Co., Cincinnati, O.—A very attractive and exceptionally well-designed and printed brochure giving numerous views at the works of this company, and half-tone illustrations of their various machines on exhibition at the Paris Exposition. The explanatory text is in English and French.

Austin Separator Co., Detroit, Mich.—A catalogue of 20 pages of illustrations and text describing the "Austin" steam separators for live and exhaust steam. Both vertical and horizontal types are shown. Several illustrations are given of oil and ammonia separators, and the "Austin" spraying device.

The Q & C Company, Chicago, Ill.—(*a*) A very handsome catalogue of 20 pages, illustrating and describing many forms of pneumatic tools for chipping, caulking, beading, riveting, drilling wood boring, flue rolling, stone cutting, and hoisting. Numerous illustrations from photographs show the tools in use. (*b*) An attractive catalogue of cold metal sawing machinery, giving numerous views of the many types of saws manufactured by this company.

Goodwin Car Co., New York.—Illustrating with photographic views the construction of the Goodwin car and its use. Diagrams are given showing how the car may be dumped in any one of nine different ways, discharging the load exactly where it is desired.

Baldwin Locomotive Works, Philadelphia, Pa.—Hardsome brochure giving a general description of the locomotives exhibited by this firm at the Universal Exposition of 1900 at Paris, and recounting the history of the house since its founding in 1832 by Mr. Mattthias W. Baldwin, the builder of the famous "Old Ironsides." Nearly 18,000 locomotives have been constructed to date by this house.

Hill, Clarke & Co., Boston, Mass.—Handsomely rubricated catalogue showing the many styles of drilling and boring machines manufactured by this firm. The illustrations are particularly attractive, and the descriptive matter is very explicit. An index to the whole facilitates the finding of any particular machine.

B. F. Barnes Co., Rockford, Ill.—A four-page circular of a new 20-inch upright drill.

M. C. Bullock Mfg. Co., Chicago, Ill.—Catalogue describing the "Bravo" hand-power diamond drill. Directions for setting the diamonds and operating the drills are given. The whole is preceded by a portrait and biography of the late Milan C. Bullock, the founder of the firm which bears his name.